



With Compliments from the Writer

HANDBOOK OF INSECTS
INJURIOUS TO
ORCHARD AND BUSH FRUITS.

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Y^{rs} very truly
Eleanor A. Bremer

ORCHARD AND BUSH FRUITS

PREVENTION AND REMEDY.

ELEANOR A. FORMEROD,

ADDITIONAL EXAMINER IN AGRICULTURAL ENTOMOLOGY IN THE UNIVERSITY OF EDINBURGH;
FELLOW ENT. SOC. LONDON; HON. FELLOW ENT. SOC. STOCKHOLM; MEMBER ENT. SOC.
WASHINGTON, U.S.A., AND MEMBER ASSOC. OFFICIAL ECONOMIC ENTOMOLOGISTS,
WASHINGTON; HON. MEM. FARMERS' CLUB; HON. AND CORR. MEM.
ROYAL AG. AND HORT. SOC., S. AUSTRALIA;
HON. MEM. ENT. SOC. ONTARIO, AND CORR. MEM. FIELD NAT. CLUB, OTTAWA, CANADA;
MEMBER EASTERN PROVINCE NATURALISTS' SOC.,
CAPE COLONY; ETC.

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TO THE MEMORY OF
MY SISTER
GEORGIANA E. ORMEROD,
F. E. S.,
THE FRIEND AND COMPANION OF THE WHOLE OF OUR JOINT LIVES,
AND
MY CONSTANT KINDLY HELPER IN ALL MY WORK,
This Volume
IS AFFECTIONATELY INSCRIBED BY
THE WRITER.

SEPTEMBER, 1898.

PREFACE.

IN the present volume I have endeavoured to collect into a convenient form for reference the most important points of information which we possess regarding the life-histories and habits of the insects of which the attacks are commonly injurious to a serious extent to hardy fruit in this country, together with notes of methods of prevention and remedy which have been found serviceable at a paying rate.

Some of the attacks mentioned have long been *known of*, but there are few if any of these of which we have not gained some additional information during the past few years, and of many of the others we have only lately become possessed of the whole life-history; whilst others, again, have lately shown themselves as perfect scourges (in our present large scale of fruit growing) which even within the last four or five years were wholly unknown to us as fruit pests.

In the following pages (as temperatures and weather influences have great effect on insect life and number of yearly broods), I have endeavoured, as far as possible, to give the information from observations in this country sent to myself during the past twenty-one years, and published as received in my successive Annual Reports; these notes being now condensed into a continuous account of each infestation, but as far as possible in the words of the various contributors.

In cases where we have not British observations of the points of life-history, or of preventive measures requisite for practical use, I have availed myself of published information, both European and American, but I have endeavoured to

acknowledge the source fully and clearly, and (here I may add) gratefully. Some of the infestations which have been little (or not at all) known of as injurious until the past few years—as, for instance, the attacks of the Flat-celled Shot-borer Beetles (*Xyleborus saxosus* = *xylographus*) in Plum wood, those of the “Ground Beetles” (*Geodephaga* of various species) to Strawberry fruit, or, again, of the Eelworm (*Aphelenchus fragariæ*) which causes distorted growth of the Strawberry plant—I have entered on at length, so as to give as much detail as was in my power.

In addition to the accounts of damage by *insect* attacks, observations are also given of a few other kinds of infestations, such as injuries by Phytoptidæ or Gall Mites, and Nemátoid Worms; and also, and very especially, the infestation known as Rust or Red Spider, scientifically as *Tetranychus telarius*, of which more information was much needed where it could be attainable for general reference.

With regard to arrangement, I have placed our ordinary fruit crops (to which the volume chiefly refers) *alphabetically*, giving under the heading of each crop accounts of the insect attacks to which it is *especially* subject; but in the case of insects which are common infestations of many kinds of trees and their produce, the observations are placed under the name of the orchard tree or fruit bush regarding which these observations were chiefly sent to me. For example, with regard to the very generally injurious pests the Winter Moths (*Cheimatobia brumata*) and some other allied kinds with wingless females, the observations are placed under the heading of PLUM, as it is not to be denied that operations giving treatment of 80,000 or more trees afford a more “broadscale” view of treatment and results than is commonly attainable. For readers who desire information as to the different kinds of fruit crops which are injured by any special insect, a glance at the “ALPHABETICAL LIST” will give all that is required.

Amongst kind friends who have especially assisted me, by help in researches which were beyond my own power to carry out fully, I beg to express my grateful acknowledgments to

Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory at Amsterdam, for kind assistance during many years in identification of Nematoid Worms, known with us as Eelworms; to Dr. A. Nalepa, of Vienna, the distinguished observer and writer on Phytoptidæ, I am indebted for much help regarding Gall Mites; and to Mr. Albert D. Michael, our own well-known acariniologist, for assistance in study of various of the *Acarina* injurious to crops. To Dr. J. Fletcher, Entomologist of the Department of Agriculture of the Dominion of Canada, and to other good friends whose help I have endeavoured fully to acknowledge accompanying their information, I beg to express my hearty thanks, as also to Mr. Oliver E. Janson, F.E.S.Lond., for much help given me, especially in identification of doubtful species of Coleoptera.

Amongst the illustrations, amounting to somewhat more than sixty in number, I beg to acknowledge with thanks those at pages 29, 151, and 246, as being by kind permission of Messrs. Blackie, of Glasgow; the moths in the figures at pages 16, 86, 133, 177, 179, 260, and moth with wings spread at page 89, are from Newman's 'British Moths'; those at pages 21, 27, 54, 210, and the moth with wings closed and caterpillar at page 89, are figures of which the use was granted me some years ago by the editor of the 'Gardeners' Chronicle.' Of the other figures, a large proportion have been drawn expressly for my publications by Messrs. Horace and E. C. Knight, artists on the staff of Messrs. West, Newman & Co., 54, Hatton Garden, E.C.; and the others, I hope, will be found to have been duly acknowledged, either together with the figure, or in the letterpress accompanying.

The frontispiece is, by permission, from a photo by Messrs. Elliott & Fry, of Baker Street, London, W.

So far as our experience shows, the protection of our fruit crops from insect ravage is likely to be an increasing difficulty, consequently on the increasing extent of the areas in which one kind of orchard tree or fruit bush is grown year after year, thus giving every opportunity for the established settle-

ment of the insect feeders on that special crop. In the following pages I have endeavoured to collect the very best information in my power as to treatment which has been found practically useful at a paying rate in keeping these infestations in check, and it would be a sincere satisfaction to me if thus the observations which many of our horticulturists and others have been good enough to place in my hands for our general service may help in some degree to preserve a fair amount of our fruit crops from insect depredations, and a fair return to the growers for their great outlay.

ELEANOR A. ORMEROD, F.E.S.

TORRINGTON HOUSE, ST. ALBANS :

September, 1898.

INSECTS INJURIOUS TO ORCHARD AND BUSH FRUITS.

APPLE.

American Blight (Woolly Aphis).

Schizoneura lanigera, Hausm.



Woolly Aphis; infested Apple spray, nat. size; wingless viviparous female and young clothed with cottony fibres above, and small egg-bearing female beneath the spray; pupa with little cottony growth; all magnified.*

The attack of the Woolly Apple Aphis, commonly known as “American Blight,” may be taken as an example of orchard infestation which is exceedingly common, very injurious by destroying the health of the tree, and yet at the

* The above figures are acknowledged, with thanks, as after 1 and 3, Plate CV., and 2 and 5, Plate CVI., in ‘Brit. Aphides,’ vol. iii., by G. B. Buckton, F.R.S. The size of the wingless viviparous female is given (p. 89 of same volume) as 1.77×1.39 millimètres, that is, something under a twelfth of an inch in length by rather less in breadth.—E. A. O.

same time is so open to remedy that it may with little expense or trouble be prevented establishing itself.

The presence of this "Apple-bark Plant-louse," or "Woolly Aphis," may be easily detected by the woolly or cottony growth on the insects, giving the appearance of a white film growing at the bottom of the crevices where a few of them are lurking. Where there are many the spot appears as if a knot of cotton-wool was sticking to the bough, or even hanging down in pieces several inches in length, ready to be wafted by the first gust of wind, with all the insects in it, to a neighbouring bough.

The "Blight" is chiefly to be found in neglected Apple orchards. Its headquarters are in crevices in the bark, or in hollows where young bark is pressing forward over the surface where a bough has been cut off, or broken by accident so as to leave a shelter of the old dead bark outside; it may, however, be found on almost every part of the tree into which the aphis can pierce with its sucker; and the harm caused by the attack is not only from the quantity of sap drawn away from the bark or young shoots, but also from the diseased growth which is thus set up. The bark is at first not much affected by the punctures, but the woody layers beneath become soft, pulpy, and swollen. The cells and fibres divide and subdivide, and the bark splits open over the swelling, showing the tissue beneath, which is thus exposed for a fresh attack.

At the end of summer these watery swollen growths dry up and die, and thus form deep cracks. With the return of spring (as in other cases of injury) a new growth forms round the dead part, and this soft tissue is ready for the young aphides. Thus, from the swollen diseased growth caused partly by the aphides, partly by the natural attempts of the tree to repair damage, a constantly increasing diseased mass arises, which shelters the insects in its crannies, and finds food for them in its young hypertrophied formations.*

The "American Blight" Aphis is stated to have been imported from America in 1787, but whether this is a fact appears somewhat uncertain. It may be known at a glance from the common Apple Aphis (scientifically *Aphis mali*), which is injurious to the leaves, by the white wool with which it is more or less covered, and from which it takes its common name.

The Woolly Apple Aphides are of the shape figured on p. 1 and p. 3, magnified, with three pairs of legs, and (when in winged condition) with two pairs of transparent wings; a

* See paper by M. Prillieux in 'Comptes Rendus' for April, 1875.

head furnished with a pair of antennæ or horns, and for the most part with a rostrum or sucking-tube, by means of which the insects (as above mentioned) cause much injury. This



Winged Woolly Aphis, magnified.

rostrum is of enormous proportionate length in the aphides when first produced, but it is stated to be absent in the egg-laying female. The "honey-tubes," or cornicles, which are to be found in the case of most aphides as upright tube-like organs placed one on each side of the upper part of the abdomen near the tip, are absent or rudimentary.

The colour differs with condition or sex, but the aphides may be generally described as of some shade of brown in their older stages, and of warm brown or red or pinkish in their earlier condition. The winged egg-producing female is yellow tinged with red.

The pupæ (that is, the aphides before grown to maturity) are "slightly clothed with down. The insects, when adult, exude from their pores long silky threads, which curve round a centre, and form long spiral filaments, under which they hide."* This wool sometimes shows merely as a film, like a little white mould in the crannies haunted by the plant-lice; sometimes it shows as tufts or patches on the trunks or boughs, or on leaves or shoots—anywhere about the trees, in fact, where the plant-lice are allowed to establish themselves. In these filmy masses the insects shelter themselves, and the young may be found collected together thus even in severe cold. I have myself found them in the woolly material during the winter, and Mr. Buckton records finding the wingless larvæ alive and plentiful on Apple branches in December, when snow was on the ground, and the thermometer stood at 21° Fahr. Winged specimens may be found in July and August.

PREVENTION AND REMEDIES.—The great harbouring points of this aphis, and the nooks from which the broods come forth in spring to infest the trees, are crevices, especially such as are formed of young bark sheltered under old dead masses. It is therefore very important to keep up a clean, healthy, well-trimmed state of the branches, such as will not allow of

* For details of *S. lanigera* see 'Brit. Aphides,' by G. B. Buckton, vol. iii., pp. 89-94.

lurking-places, or, if they do exist, will allow of these points of attack being carefully watched. Boughs must be removed in pruning sometimes, and where the Woolly Aphis exists it is certain to try to effect a lodgment under the ring of young bark that comes rolling forward over the stump; but an eye to this matter, and a few strong soap-suds brushed on the first bit of wool seen, will keep all right; whilst on trees with the boughs maimed by beating the crop off, bad pruning, pieces torn off by the wind, &c., the aphis gets such a hold in the rough bark as can hardly be got over.

With regard to remedies:—The colonies of insects remain in one place, and soon die if their food is cut off or their breathing-pores choked; so that anything which will give such a taint to their harbouring places that they cannot feed will do good. *Soft-soap, tar, or, in fact, anything oily, greasy, or sticky that can be well rubbed on*, and which, by adhering for a time, will choke all the aphides that it touches, will be of use, and amongst these applications tar, being often at hand ready for use, may answer the purpose where nothing else would be used. But it should always be remembered, though this application may not do harm where old thick bark prevents it oozing or melting (in sunshine) into the living tissues of the tree, or, again, might be perfectly safe on the blight-tumours of old trees, it would probably be *very injurious* on young bark that is still living and in an active state.

Amongst the vast number of applications which are on record as answering for getting rid of this attack, probably the following recipe, with which I was favoured by Mr. Malcolm Dunn, writing from The Gardens, Dalkeith, N.B., would be found to meet all requisites with little trouble or expense:—

“I find soft-soap an excellent insecticide wherever it can be applied with safety to the plant; made into a thick lather, and applied with a stiff brush to the stems of Apple trees infested with American Blight, it is a certain remedy.

“In the winter, when the trees are at rest, it may be applied all over the tree, and if the roots are uncovered from the base of the stem onwards, as far as it is easy to get at them also, the treatment will go far to stamp out the pest. Even a thorough soaking of the soil in which the roots run, with strong soap-suds, repeated a few times during winter, is a first-rate means of keeping down American Blight. Of course the soft-soap must not be applied (as above) to green leaves or bark; it is so caustic that it invariably burns them, especially if the sun strikes on the soap; therefore it must be used with caution in summer.”—(M. D.)

The above recipe is particularly serviceable in cases of American Blight being established at roots of Apple trees.

At one time there was some doubt whether the Woolly Aphis found on the roots was of the same species as that affecting the tree, but now it is considered similar; and it is advised also by Dr. Asa Fitch, where Woolly Aphides are found on the roots, to clear away the soil as much as possible from the infested roots, and pour strong soap-suds in sufficient quantity to soak into all the crannies or diseased spots, and either to remove the old soil and replace it with fresh, or to mix ashes with it.

Another observer recommends partially laying bare the roots, and following this up by the application of night-soil. Drainage from stables is said to cure the evil. As the root aphides in all likelihood pass down from the trunk, it would probably be a great preventive to put a loose rope of hay soaked in tar round the tree at its junction with the ground, placing the band so as to stop passage but not injure tender bark.

For *washes, or mixtures* to be laid on as paint, the following applications have been found of service; but it should be observed that in the case of tobacco-water it is desirable to try what strength tender *leafage* will bear without injury:—Take a quarter of a pound of tobacco, infuse it in half a gallon of hot water; when cool enough dip the infested shoots in it for a few seconds, or wash the infested parts in the liquor. Repeat this in a few days, if necessary, after which the plant may be washed with clean water. Then dissolve one pound of soft-soap and one gallon of lime in enough water to make it about the consistency of thick whitewash. Apply this with a painter's brush to the stem and all the branches that can be reached, and sift some lime on the ground.

An application is also recommended of half a peck of quick-lime, half a pound of flour of sulphur, quarter of a pound of lamp-black, mixed with boiling water so as to form a thick paint; this to be applied warm. In winter, when the leaves are off, the branches and stems may be painted with this, *all loose bark being first removed*. It is very desirable to remove the soil from the bottom of the stem, down to the main roots, and paint that part also.

For special applications to nooks and crannies, anything that is oily, soapy, or greasy will do good, but, as far as killing the insects is concerned, the thicker it is the better, so that it may fairly fill up the crevices in the bark, if possible, and not run off the aphides till it has killed them by choking up their pores; but at the same time care should be exercised not to oil or grease *young* bark that may be hurt by the application. A simple lather of yellow soap, laid on with an old shaving-brush, sometimes does all that is needed without

fear of hurting the plants, and soft-soap, well rubbed in, would probably be a very effective and lasting remedy.

It is also recommended that about the end of February the trunks and *large branches should be scraped*, excrescences cut off, and the whole well scrubbed with soap-suds, after which a good coating of lime and water is recommended. Probably the form of "whitewash" that has some "size" in it would be better than the simple lime and water, as the "size" makes it stick better, and thus it is more injurious to the aphides.

Besides the above applications, so many others are mentioned as being used with more or less success, it may be worth while to give the list in some kind of order. It includes tar, kerosine, paraffin, turpentine (diluted), also resin (with an equal quantity of fish-oil, and put on warm); oils of various kinds; soaps of various kinds; ammoniacal-liquor from gasworks, and ammoniacal animal fluid, especially drainings from stables; tobacco-water; paints of lime and soap; lime and sulphur; whitewash; oil and soot; and also plaster of grafting-clay to stop up chinks with the blight enclosed.

Of this vast collection of means of remedy, probably the most serviceable are thorough drenchings of some of the soap-washes, applied by means of the garden-engine to the tree directly the attack is noticeable, accompanied by special applications of thick mixtures of soap, or of any kind known to be desirable to kill such of the blight insects as may have remained sheltered in crevices of the bark.

A careful watch, and something done as soon as the wool appears, is what is wanted; but if the small tufts are left alone, as of no consequence, the insects will soon spread far and wide, and a thoroughly infested tree may be a serious injury to a whole neighbourhood.

Apple Aphis (Green Fly). *Aphis mali*, Fabr.

This kind of aphis is found in great numbers on the twigs and in the leaves of Apple trees distorted by their attacks, and likewise to some degree infests Pear trees, Quince, Medlar, and Hawthorn; but the great mischief which it causes as an orchard pest is by the young aphides puncturing the back of the Apple leaves with their suckers, and thus causing them to curl backwards, and form shelters for the insects, in which they are safe not only from weather, but from being got rid of by artificial applications.

The beginning of the attack is by deposit of eggs in autumn ; these are at first yellow or green, but gradually become darker, and may be found in winter, sometimes in very great numbers, as oval black shining eggs in crevices of the bark, or on the young apple twigs. These hatch as soon as the buds begin to swell in the spring, and the little plant-lice at once betake themselves to the buds or small sprouting leaves, where they feed by inserting their suckers and drawing away the juices.

These plant-lice are females, and reach maturity in ten or twelve days, when they begin to produce living young, which in their turn reach maturity as quickly as their mothers, and are as prolific. Thus the colony increases as quickly as the growth of new leaves supplies them with places of settlement. With advance of the season winged aphides are produced, which abound most in July, when they spread so widely and so numerous as sometimes in the Apple-growing districts to do most serious mischief by the injury to the leaves ; and the bark of the trees is (as in various other cases of aphid attack) blackened by the secretion voided by the insects.

The presence of the infestation is noticeable by the Apple leaves being twisted and turned back, or otherwise distorted out of their natural shape and position.

Towards the end of the season males as well as females are produced, and egg-deposit takes place, which lays the foundation for the attack of the following year.

The winged female producing living young (viviparous) is of very similar shape to the *Aphis pruni* figured under the heading of Plum Aphis, that is, has six slender legs, two pairs of delicate wings, slender and rather long horns, and near the end of the abdomen (one on each side) a pair of cornicles or honey-tubes. The Apple Aphis, however, differs in the wings being proportionally longer and narrower than that of the Plum, and the colouring is rather different.

This species of Apple Aphis is stated to be very variable both in form and colour. Of the females that produce *living young*, the *wingless ones* (hatched from the egg first in the season, which may be called the mother-aphides of the successive generations of the year) are globose and soft, larger than those born from these aphides afterwards, of a dark slaty grey colour, mottled with green, with short dark grey horns and legs. The latter viviparous broods are variable in colour, as green, yellowish, rusty red, &c. The *winged female* bearing *living young* (*viviparous*) has the head, horns, and body between the wings black ; abdomen green, with dots on each side ; legs yellowish, with black knees and feet. The wings are long, and pale green at the base. The *wingless egg-laying*

female is almost globose, of a brownish green colour, with a rusty stain on the head and part of the thorax. The tail and rings next to it are very hairy.

In the case of this plant-louse, there are wingless males; whether there are winged ones also, appears not to be certain. The wingless kind is described as "exceedingly minute, perhaps one-eighth the size of the female" (of which the greatest length given is about the tenth of an inch); legs long; horns longer than the body, and sucker almost equal to it in length.

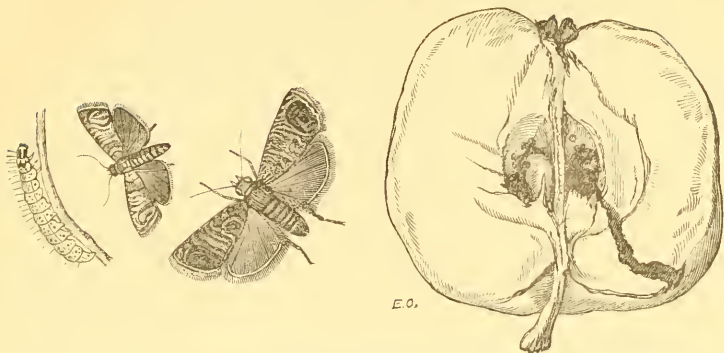
The early stages of this species of plant-louse much resemble each other in form; the pupa, however, has reddish wing-cases; also, it is usually of a paler yellow in colour than the larva, and has three green stripes on the abdomen.—('Mon. of Brit. Aphides,' vol. ii.).

PREVENTION AND REMEDIES.—*Scraping* the dead bark off the trees during the winter, and *washing* them with a solution of soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing soda in water, is recommended in Canadian practice as being beneficial by destroying the eggs. Later on washes and syringings of soap-suds. Soft-soap with a little paraffin incorporated, but not strong enough to hurt the leafage, and all the usual class of aphid washes, will be of use where they can be brought to bear on the aphides.

In the case of this aphid, which blackens the bark and gives the tree a sickly smell from its excretions, thorough and repeated washings that will clean the leaves and shoots, as well as knock off the aphides, are particularly useful. Where shoots are still in the first stages of attack, before the leaves are ruined, good drenchings *applied powerfully* by means of the garden-engine are useful for this purpose, and they may be of water or of any of the washes mentioned; but washes containing soap or anything that will adhere to the aphid, instead of being repelled by its mealy coat when in larval or pupal state, are the most useful.

It is desirable to *cut off all infested shoots* that are past hope of recovery, or can be spared, and destroy them at once, so as not to allow the aphides on them to fly or otherwise get about.

The common Blue Titmouse is especially useful in destroying aphides; and the Cole, Marsh, Long-tailed, and Great Titmouse; also the Lesser Spotted Woodpecker, the Creeper, the Nuthatch, and the Warbler are stated to be serviceable in clearing insects from Apple trees.

Codlin Moth. *Carpocapsa pomonella*, Linn.

CARPOCAPSA POMONELLA.—Moth, natural size and magnified ; caterpillar ; injured Apple.

Codlin Moth attack is one of the regularly recurring yearly troubles of the fruit-grower, and although the “maggotty” or “worm-eaten” condition of the young fruit, which we know only too well as causing it to fall in quantities before it is large enough to be of any use, may sometimes arise from Apple Sawfly presence, or from other infestations, yet for the most part the mischief is due to the larvæ of *Carpocapsa pomonella*.

Other of our orchard fruits are also liable to this infestation. Pears are sometimes much injured ; Quince, Plum, Peach, and Apricot are sometimes attacked ; Walnuts have been found to be infested ; * and this species has been recorded as having been bred frequently from Sweet Chestnuts.

The caterpillar, or larva, when full-grown, is from rather under two-thirds up to three-quarters of an inch in length ; at first it is whitish, later on more or less of a pink or flesh-colour. The head when young is blackish, later on lighter in colour ; the shield on the segment next the head varies similarly in colour with age of the grub, and so does the tail segment. It has “eight little black dots or warts on each segment, so arranged as to make two rows down the back, and one row on each side” (Frazer S. Crawford). The caterpillar has three pairs of claw-feet ; four pairs of sucker-feet beneath the body, and another pair at the end of the tail.

The cocoon is given by Dr. L. O. Howard as “white inside and greyish outside, and usually covered somewhat with bits of bark or minute fragments of whatever substance the worm happens to spin on.”

* See ‘The Entomologist,’ January, 1896, p. 2.

The moth is about four-fifths of an inch in spread of the fore wings, of a somewhat brown tint looked at generally, but the fore wings have a brown patch at the tip, in which are markings of gold colour, or of golden scales, or streaks of gold; and the wing is varied (see figure, p. 9) with irregular transverse streaks of brown and grey. The brown of the hind wings is deepest towards the outer edge, but the general appearance of the moth differs much in marking, from brightness to dull grey or brown, according to whether it is held in the bright sunshine or otherwise.

The male moths are distinguishable from the females by the presence of a narrow long blackish spot on the under side of each front wing, and also by a very narrow line of rather long black hairs along the upper surface of each of the hinder wings.*

The method of infestation is for the moths to come out about the time of the opening of the Apple-blossoms, and when the petals have fallen and the embryo fruit is beginning to form, the females lay their eggs; formerly it was supposed especially at the eye or blossom end of the fruit, but according to recent observations it appears that the eggs may be attached anywhere,—to the surface of the fruit, or to its stem. (For minute observations of details of egg-laying, &c., with authorities given, the reader is referred to the exhaustive pamphlet of Prof. Slingerland noted below.)

The maggot hatches in about a week or ten days, and burrows into the embryo Apple for the most part at what may be called the blossom end (the end furthest from the stalk), and gradually begins to tunnel a gallery towards the core, and during the journey their excrementitious matter is so far as possible thrown out at the entrance-hole, and by this dirt, especially the brown matter collected at the “eye” of the young fruit, attention is called to the mischief going on within. As the grubs grow they feed for the most part at or near the core, and on the seeds, and at this stage do not appear to clear out the dirt, so that the centre of the Apple becomes a discoloured mass, as shown in figure, p. 9.

In about four weeks from the date of hatching the grub is full-grown, and as a preliminary to leaving the Apple it gnaws a tunnel to the outside of the Apple (see also p. 9), and leaves the fruit. This may be in various ways. For the most part it appears to be by simply crawling out of the Apples, which have fallen consequently on the injury within, often (though by no means always) with the maggot still inside them. Sometimes the larva or maggot lets itself down

* See ‘The Codlin Moth,’ by M. V. Slingerland; Bulletin 142, Cornell University Agricultural Experiment Station, U.S.A., January, 1898, p. 13.

from the fruit (whilst this still remains on the tree) by the help of a silken thread spun from its mouth; or, again, it may simply creep out of the Apple, and make its way along the branches to the trunk.

But whether by creeping from the fallen Apple along the ground, or by leaving it in any other manner, the maggot next makes its way to a neighbouring Apple-tree stem, and there it shelters itself in a cranny of the bark, or under a loose piece, and often hollows out a little cavity, and spins a cocoon, thin in itself, but from being mixed up with little bits of surrounding material it forms, where I have seen it, a very substantial protection. From this the moth comes out in about a fortnight, or in the following spring, according to whether there is one brood or two in the course of the season. In England it is considered that this moth is actually only single-brooded.

The matter of number of broods is important practically, as in reference to imports from countries—as France, for instance, or the greater part of the United States of America—where the Codlin Moth is considered to be double-brooded, for in such circumstances many of the maggots may be in the apparently good Apples when gathered, stored, and packed.* The maggots come out presently, and spin their cocoons in any convenient cranny of the barrel or other packing-vehicle, or locality. Thus a large supply of infestation is quite likely to be imported together with the Apples to their purchasers, and set infestation on foot where transmitted to fruit-grounds.

Irregularity of development, so that “about the same time full-grown larvæ, young larvæ, eggs, and pupæ will be found,” is another point to which Mr. Howard draws attention, and to which, from my own observations of the past year, I think attention might usefully be given here.

PREVENTION AND REMEDY.—Where fruit is found to be falling prematurely in large numbers, some of it should be split open, and if infestation of Codlin Moth caterpillar is found inside, the fruit should be gathered up and destroyed. This should be done as soon as possible, if it is to do much good; and jarring or shaking the boughs of trees which are apparently much infested, on to cloths, answers well, for thus a good proportion of the infested Apples can be gathered up before the grubs have time to get away, and the fruit can be thrown at once to wet manure or destroyed in any convenient way.

* See “The Codlin Moth, *Carpocapsa pomonella*,” by L. O. Howard, in ‘Report of the Entomologist of the United States of America Department of Agriculture for 1887,’ Washington, 1888, pp. 88–115; an excellent and exhaustive treatise.

In orchard-growing on the very large scale of U.S.A. cultivation, it has been found to answer well to feed sheep and pigs on the ground. These are supplied with requisite amount of dry food, and from the destruction of the maggots and trampling and manuring of the ground the infestation was found to be much lessened, and also the trees to thrive well. To prevent gnawing of the smaller trees, a wash of "a solution of soapsuds, whale-oil soap, and sheep manure was applied once a month, and water also given."* In this country the water might or might not be needed.

But though destroying the fallen Apples gets rid of a great deal of infestation, it does not help us with regard to the caterpillars that go down to the ground by threads, and creep up the Apple trunks; or creep down to the trunk from un-fallen Apples on the twigs. For this we need various methods of treatment of the bark, and the first in order are those for trapping or stopping the maggots on their ascent (or on their journey down the tree). A very simple plan recommended by the late Prof. Riley, Entomologist of the U.S.A. Department of Agriculture, was to wind a *hay-rope* in three coils round the trunk of a tree at a little distance from the ground, and to apply other hay-bands also to the larger branches. The hay-band was fastened as tightly as it could be pulled; and Prof. Riley's rules as to its application were as follows:—"First, the hay-band should be placed around the trees by the 1st of June, and kept on till every Apple is off the tree; second, it should be pushed up or down, and the worms or chrysalids crushed that were under it, every week or at the very least every two weeks" [this appears to me very important, E. A. O.]; "third, the trunk of the tree should be kept free from rough old bark, so as to give the worms no other place to shelter; and, fourth, the ground itself should be kept free from rubbish."†

The point of the above treatment is—have the bands for trapping the maggots placed early enough, and clear out all that are captured soon enough; and remove all other shelters, so that the maggots have (so to say) no choice but to resort to those which can be kept under observation.

With a similar object, *banding the trees*, as especially recommended by Mr. Frazer Crawford, may be carried out in various ways, as follows:—"For this purpose, old sacks, old clothes (if woollen all the better), or brown paper may be used, but the latter is not so good. These should be cut into

* See detailed account, by Mr. J. S. Woodward, in 'New York Weekly Tribune' for June 9th, 1880, quoted at length by Mr. L. O. Howard, p. 96 of his paper previously referred to.

† See Mr. L. O. Howard's Report previously referred to.

strips about eight inches in width, and of a sufficient length to go round the trees. Each strip should then be folded in half, and the folded edge again turned down, so as to make the double fold about an inch and a half wide. The band will then be about two and a half inches wide. Insert a piece of cord, or, what is better, wire, in the double fold, and tie round the trunk of the tree, about six inches from the ground, taking care that the folds are at the top, and the second fold placed next the tree. . . . The wire can easily be untwisted to examine the bands, and twisted again to fasten them on. The bands should be examined weekly as long as there is any fruit left on the trees, as also on any tree which, having no fruit, is yet growing near infested trees with fruit on. Rags or paper should be fastened in the forks of the trees, in order to trap any caterpillars that may leave the fruit without reaching the ground, which, of course, should be examined regularly with the others.”*

For a simple and practicable method of scraping the trees so as to clear away all shelters for maggot infestation, I do not know of any better plan than that recommended by Mr. Frazer Crawford in his pamphlet referred to below, therefore I again quote verbatim, duly acknowledging the source:—“Spread any old sacks or other suitable material round the tree as far as any scrapings are likely to fall. Commence on the tree as far as there is any loose bark, and scrape it carefully off. Examine and scrape all crevices in the bark, or those formed in the forks of the tree. Continue scraping until the ground is reached. Next gather the scrapings carefully off the sacks, and burn or otherwise destroy them immediately. This scraping should be done annually early in the winter.

“Washing the trees.”—After scraping the trees a wash should be applied for the purpose of destroying any larvæ or chrysalises remaining in the crannies of the tree.”—(F. S. C.)

With regard to washes, it is really impossible to enumerate the variety that are before the public that would answer the required purpose. Such preparations as kerosine emulsion; or the “anti-pest” of Messrs. Morris, Little, & Son, of Doncaster; or the soft-soap and sulphur compound of the Chiswick Soap Company, or many others with a basis of coarse strong-smelling soap which would fill up crevices and stifle larvæ within them, and an addition of some special insect deterrent as mineral oil or sulphur would be sure to do good.

To the above precautions should be added (where the large

* ‘Report on the Fusicladiums and Codlin Moth,’ &c., by Frazer S. Crawford, Inspector under the Vine, &c., Protection Act. Published by direction of the Hon. Commissioner of Crown Lands. Government Printer, Adelaide, S. Australia, 1886. Price 1s.

scale of trade cultivation is concerned) great care as to bringing infestation into the grounds in cases which may have held home-grown or imported Apples. As noted at p. 11, larvæ or maggots of the *second brood*, in some European and many of the U.S.A. districts, may have been in the Apples when packed, and may very likely indeed have established themselves for change to chrysalis and moth state in crannies of the barrels, boxes, crates, or other cases used for transmission. All such packages, or even such as have been in contact with such cases, should be disinfected. Thorough scalding with boiling water would probably do all that is needed, and this simple plan would often be carried out where growers would not care for more trouble. But for those who wish for a special application, "dipping the cases for two minutes in a lye of caustic soda of a strength of one ounce to three gallons of water, or pouring the solution into them," will be found useful.

Spraying.—But it has become more and more observable that something beyond measures of prevention are needed, which, in localities where the infestation has escaped all measures for its destruction in its early stages (or more commonly where nothing has been done to destroy it), may be brought to bear cheaply, and with good hope of success, at the time when attack customarily takes place on the young setting Apples, that is, when the blossom-leaves are falling, or rather have just fallen. *For this purpose spraying with Paris-green* has been found to answer well.*

In the Report of Prof. Lawrence Bruner, Entomologist of the University of Nebraska, U.S.A., bearing date 1894, which brings the observations fairly up to the present time, he observes:—

"The best remedy now known, and the only one by which the first brood is killed and a large percentage of the fruit saved from their ravages, is the use of one or other of the arsenical sprays, composed of London-purple or Paris-green with water. These are to be applied just after the fruit has 'set,' and before it has become heavy enough to droop, or for the calyx ends to turn downward on the forming fruit. One or two thorough sprayings at this time will, it has been proved, save at least seventy per cent. of the loss otherwise experienced. The ratio of these poisons best adapted for the purpose has not been definitely ascertained, since this varies with conditions of climate, latitude, &c." [A caution that should be carefully noticed.—E. A. O.] "About four ounces of the Paris-green or three of the London-purple to the barrel of water will probably be sufficiently strong to kill the

* London-purple would answer the same purpose, but has not as yet been so much brought forward in this country.

worms, and at the same time not injure or kill the foliage during ordinary weather at this time of year.”—L. B. (From ‘Nebraska State Horticultural Report for 1894.’)

The above extract gives date of application, but (to ourselves) not precise proportion save to those acquainted with the capacity of the U.S.A. “barrel.” But reports from trustworthy experimenters name one pound of poison to a hundred and sixty to two hundred gallons of water as safe and serviceable.

Prof. F. M. Webster, of Purdue University, U.S.A., also a thoroughly trustworthy authority, recommended Paris-green, sprayed as a liquid mixture, as a good remedy. “Used in this form, one pound of the poison to one hundred and forty or fifty gallons of water, if applied in the form of a spray, by the aid of any of the machines mentioned, . . . will be found effective against the Codlin Moth.”—(F. M. W.)

In our English experiments, for spraying Apple trees as a remedy for caterpillar, one ounce of Paris-green to twenty gallons of water was found sufficient. But in all cases where the operators are not accustomed to the use of arsenical poisons, careful experiment should be made as to what strength can be borne, before spraying on a large scale.

The Paris-green is procurable from Messrs. Blundell and Spence, Hull, more finely ground than the ordinary powder, and in a slightly damped condition; in this condition it is safer for use, as the powder does not fly about, and is therefore not so liable to be prejudicially inhaled by the mixer. Also a smaller quantity is required; if the same proportion of this prepared Paris-green is used as of the ordinary powder, great damage is likely to ensue. Paris-green is sometimes known in the shops as Emerald-green.

It must be remembered, as was brought forward when the use of Paris-green was introduced into England by our Evesham Committee of Experiment in 1890, that this acetoarsenite of copper is poisonous, and therefore should be kept safely out of the way of children or careless people.

Details of method of application are now fully before the public, but the main points will be found under heading of “Paris-green”; and for those who wish to have special observations on methods of applying the arsenite, and also precautions in its use, I may mention that I should be happy to forward gratuitously to applicants copies of my own eight-page pamphlet on this subject.

The kinds of sprayers, whether as knapsack or hand or horse machines, are being so constantly improved, and they are in such numbers before the public, that it is unnecessary to enter on them here.

Our really available remedies against this infestation appear

to lie—first, in destroying infested Apples; second, in trapping the caterpillars and destroying their shelters; and third, on being well on the alert at the time of the blossoming of the Apple, and by careful spraying preventing the very beginning of the attack.

Figure-of-8 Moth and Blue-head Caterpillar.

Diloba ceruleocephala, Linn.



DILOBA CERULEOCEPHALA.—Figure-of-8 Moth, and ("blue-head") caterpillar.

The caterpillars of this moth feed on the leafage of various kinds of orchard trees, especially of Apple and Plum, and also of Hawthorn and the Blackthorn or Sloe. In some seasons, especially about 1890, specimens of these fine larvæ were regularly sent amongst samples of the various kinds which were doing mischief in the orchards, but for some years back they have only rarely been forwarded.

The Figure-of-8 Moth is about an inch and a quarter in the spread of the wings. The fore wings brownish or grey-brown, marked, as shown above, with black lines and white spots, one pair of which, formed of two small white kidney-formed figures in the middle of each wing, form the marking like the number "8," which gives its name to the moth. The hinder wings are brownish, with darker rays and dark patch at the hinder angle, as figured above.

The eggs are laid singly in September on the stems and branches of the trees, or sometimes in clusters of six or eight at the base of lateral shoots. These are said by some writers to be green in colour; but in some observations by the late William Buckler of eggs of this species taken during the winter, he mentions that "they were brown and apparently ribbed, but the ribs could not be counted, as they were so curiously covered with brown hairs." *

The eggs hatch in the spring at the time of the appearance of the young leafage, and the caterpillars are full-fed about

* 'Larvæ of British Butterflies and Moths,' by W. Buckler (Ray Society), vol. iii. p. 1.

the middle of June, when they are very observable from their comparatively large size, and are also remarkable for the small head being of a bluish colour, with two round black spots. The caterpillar is of various tints of green or smoky-green above, and yellow-green below; one yellow stripe (interrupted at distances) runs along the back, and one yellow stripe along each side below the spiracles. The segments or rings of the caterpillar are spotted with black (see figure, p. 16), the one immediately behind the head has eight small spots arranged (on the upper part) in a double transverse row, and the two segments immediately behind have one row of larger spots similarly placed. The following segments (till near the tail) have four spots above. The three pairs of claw-feet are also spotted with black, and the four pairs of sucker-feet beneath the body have two black spots on each. They are, however, very variable in colour; the young specimens being sometimes nearly white on the back, and when old they may be of a bluish grey colour along the back. There are also bluish green varieties.

When full-fed the caterpillars spin cocoons formed of bits of bark, or apparently anything that may be convenient,—on twigs or stems, or even on neighbouring walls,—in which the larva turns to a reddish brown chrysalis, out of which the moth emerges about September, but also is to be found later on, and in some cases appears in the following spring.

PREVENTION AND REMEDIES.—It is stated by Dr. Taschenberg that the caterpillars have such slight hold that in case of a storm occurring they fall off in great numbers. This fact of their loose hold may be very serviceably turned to account by shaking the trees well, and also by heavy washings, and collecting and destroying the caterpillars that drop to the ground.

Amongst measures of prevention, scraping and cleaning the bark of the trees and branches would be serviceable here as with various other insect attacks, as thus some at least of the cocoons which the blue-headed caterpillars form on the trees would be got rid of.

Catching the moths by means of lamps.—The moth may be found from September onwards in the latter part of the year; and on November 18th Mr. C. D. Wise reported to me from Toddington, “We have found and are now catching, by means of the lamps, the Figure-of-8 Moth.” The arrangement used in this case was by placing a lighted lamp under an open shed, the underneath part of the roof or boards being tarred and greased.

The various kinds of washes or sprayings used to destroy

other orchard moth-caterpillars (for which see Index) would be equally serviceable in the case of this attack.

Goat Moth. *Cossus ligniperda*, Fab.



COSSUS LIGNIPERDA.—Goat Moth and chrysalis.

The caterpillars of the Goat Moth are injurious by gnawing large tunnels in the solid wood of various kinds of orchard and timber trees, where they feed before turning to the chrysalis state for three years. Amongst timber trees, they attack Oak, Elm, Ash, Beech, Lime, Willow, and Poplar; and amongst orchard trees, Apple, Pear, and Walnut,—and I have had specimens showing very injurious amount of presence of caterpillars sent me from Apple.

The infestation is widely distributed, from the south of England to the north of Scotland; and I had notes of an old Oak cut down on the Brahan Estate, near Dingwall, Co. Ross, N.B., being found to contain hundreds of the caterpillars, from a quarter of an inch to four inches in length, with empty chrysalis-cases in the bark. The worst attack which I have myself seen was in West Gloucestershire, where I helped in taking sixty caterpillars from the stem of a young Chichester Elm, which was so much injured it had to be cut down consequently on the presence of the infestation.

The habit of the Goat Moth is to lay her eggs at the lowest part of the tree, and a badly-infested tree may often be known

by the wood-chips thrown out from the caterpillar-workings, which lie on the ground close to the trunk, as well as by the moisture where sap is oozing from the gnawed-out tunnels ; likewise by the very offensive smell of the caterpillars, which thoroughly impregnates their tunnels and all about them, and from which the Goat Moth takes its name.

The eggs are laid about the middle of the summer in crevices in the bark, and the caterpillars which hatch from them feed at first in the bark or just below it, and gradually, as they grow, penetrate into the solid wood, where they live for three years, and form chambers and galleries of various size and width, some as large as a man's finger ; and from the great size the caterpillars grow to, likewise the numbers they are sometimes found in, they do great damage, or sometimes entirely kill the tree.



Caterpillar of Goat Moth (not full-grown).

The above figure gives the appearance of the caterpillar when about two-thirds grown. When quite young it is pink, almost precisely the colour of a boiled shrimp ; when older it is yellow, with a black head, two black spots on the ring behind the head, and a row of dark reddish patches or a stripe of the same colour along the back. When full-grown the caterpillars are three inches or possibly more in length.

During the winter they lie quiet, otherwise they feed for a period of three years, and, when ready to change, form cocoons of little bits of wood roughly spun together just inside the entrance of their burrows, in which they turn to a reddish brown chrysalis. Shortly before the moth is ready to emerge the chrysalis forces itself partly through the cocoon, where the empty case remains sticking out from the tree, and is a useful guide as to timber being infested.

The moth is between three and four inches in the spread of the fore wings, which are mottled with ashy white, and rich brown, with many irregular black streaks and markings ; the hinder wings are of a more dingy colour, with the markings less distinct ; the head dusky brown ; body between the wings marked across with dark brown and grey or ochreous ; the abdomen brown and grey in alternate rings. It is to be seen at the end of June and beginning of July.

PREVENTION AND REMEDIES.—The moths are heavy and sluggish, and may be taken easily by hand as they rest quietly during the day on the bark of the tree out of which they hatched.

The caterpillars sometimes leave the trees, and may be found straying about in May and in the autumn, and in such case they should always be destroyed; but generally (as above mentioned) they change to chrysalids at the entrance of their burrows, and where trees are known to be infested these reddish *chrysalids* should be looked for during June or early in July, and destroyed where found.

Any mixture that can be laid on the tree, so as to prevent the moth laying her eggs on the bark, is useful.

A mixture of clay and cow-dung smeared over the bark has been found to answer well, and has the advantage of gradually washing or cracking off without injuring the bark beneath it. Soft-soap has also been found useful applied as follows:—Several pounds of the soft-soap are mixed in a pail with warm water to about the consistency of thick paint; the operator, who is also supplied with a bag of sand and a coarse cloth, dips the cloth in the soap and sand and rubs the bark thoroughly, and then, with a painter's brush, lays on a thick coat.

This treatment is a good means of preventing oviposition, and also of rubbing off or destroying eggs that may have been laid on the bark; but in some cases a good *syringing* with a garden-engine, of some of the soft-soap washes with a little mineral oil in them, might do better, for they would run down a little way into the ground, and thus deter attack which sometimes is begun a little below ground-level. In the case of an attack on some Poplars and Willows near Llanelly, South Wales, of which specimens were sent me in 1883, the caterpillars had made their way into the wood at the lower part of the stems of the trees below the surface of the ground, and had bored upwards.

Where the caterpillars can be reached, the simplest and best method of getting rid of them is by killing them in their burrows by passing a bit of thick strong wire up the tunnel. A glance at the state of the end of the wire, when it is withdrawn from the hole, will show whether the caterpillar has been reached or not. If the end is found to have wet, white matter on it, the caterpillar has been reached. I have also seen it answer very well to use a finer wire with the point turned back, so as to form a hook to draw the caterpillar out with. A surprising number may be taken out this way.

Paraffin oil, or a mixture of it in soft-soap wash injected by a sharp-nozzled syringe with as much force as possible into the holes where the caterpillars are working, is a good

remedy; and any fluid poisonous to the caterpillar, or which would make the wood of its hole poisonous or distasteful to it for food, would be serviceable, as tobacco-water, &c. The fluid might also be easily injected by means of a gutta-percha tube, of which one end was fitted on the nozzle of a syringe, and the other passed a little way up the hole; the escape of fluid may be prevented by some soft clay being pressed into the hole round the tube or nozzle and also kept carefully in place whilst it is being withdrawn.

The fumes of sulphur blown into the hole were found very effective by Mr. Malcolm Dunn, of Dalkeith, in destroying the caterpillars of the Leopard Moth; and probably this application, or a strong fumigation of tobacco, would be equally serviceable in the case of the Goat Moth caterpillars.

Where a tree is much infested, it is the best plan to cut it down, split it, and destroy the caterpillars within; as many as sixty or more caterpillars may be taken from one tree, and when in this state it will never thoroughly recover, and it becomes a centre to attract further attack, as well as one to spread infection.

It has been noted by Prof. Westwood (Life-President of the English Entomological Society), that "the Green Woodpecker preys on these caterpillars, and its stomach on dissection has an intolerable stench," and the same circumstance is alluded to in vol. iii. of Macgillivray's 'History of British Birds.'

Lackey Moth.

Bombyx (Gasteropacha) neustria, Linn.; *Clisiocampa neustria*, Curtis.



BOMBYX NEUSTRIA.—1, cluster of eggs; 2, caterpillar (about one-third longer and wider than natural size); 3, moth.

The caterpillars of the Lackey Moth are injurious to the leafage of Apples and other orchard trees, as well as to White-

thorn, Sloe, Oak, Elm, Birch, &c. They are very easily known by their gay colouring, from which they take their German name of "Livery Caterpillars," and the moth the name of "Lackey Moth." When full-fed (which is about midsummer) the caterpillars are about an inch and a half in length, and hairy; of a bluish grey colour, marked with two black eye-like spots on the head, two black spots with a scarlet space between them on the next ring, and three scarlet or orange stripes along each side, between the two lowest of which on each side there is a blue stripe; these gaily-coloured markings being divided by lines of black, or black spotted with blue. The eggs are laid in the summer or autumn of the preceding year to that in which the attack takes place, and they may be found in winter and spring arranged in a compact mass, or rather ring-like band on the twigs, exactly as figured (p. 21). From these eggs small black hairy caterpillars hatch about the beginning of May, and immediately spin a web over themselves, which they enlarge from time to time as needed for their accommodation. In these web-nests they live in companies of from fifty to two hundred, and from them the caterpillars go out to feed on the leaves, returning for shelter in wet weather or at night. When alarmed they let themselves down by threads, either to the ground, or else (after hanging in the air till the alarm is past) they go up again by their threads to the tree. When full-grown, which is about the middle of the summer, they scatter themselves separately, and *do not go down into the ground* to turn to chrysalids, but spin cocoons anywhere in reach of their food-trees, as on leaves, or in hedges, beneath the bars of railings, under roofs of sheds, or even on the top of walls, where each caterpillar spins a silken cocoon, mixed with sulphur-coloured or white powder and with hairs from the skin woven into it, and from the brown chrysalis in this cocoon the moth comes out towards the latter part of summer.

The figure (p. 21) shows the shape and size of the Lackey Moth. The colouring is excessively variable, but the fore wings may be described as of some shade of rusty-fox, yellowish, or dark brown tint, with two transverse bars, these being sometimes of a pale tint on a darkish ground, or sometimes, on the contrary, the ground colour is the paler, and the bars dark; and in one specimen before me there is a transverse band between the two bars, of a deeper colour than that of the rest of the wings. The hinder wings are also of some tint of brownish colour.

It is stated that the moths, and especially the females, for the most part remain concealed by day under leaves and in long grass, and come out at night.

The caterpillars seldom do the enormous quantity of mischief with us that they are noted as causing in France, where, according to the old law, it was compulsory on proprietors to have the webs on the shoots cut off with shears and destroyed, in consequence of the ravages of the caterpillars (if left unchecked) ruining the Apple-leafage over an extent of miles of country; nevertheless their attacks are often the cause of much loss in this country, and need attention.

PREVENTION AND REMEDIES.—Some good may be done by looking for the rings of eggs on the shoots, cutting these off and destroying them; also by destroying any yellow silken cocoons that may be found about the trees, or near them, but these methods are tedious, and, though they are of use where just a few trees can be carefully tended, are of little service in orchard treatment.

A far better way is to *watch for the webs*, and, as soon as they are seen, to carry out the old French method and cut the shoots through with a pair of nippers and destroy the web-nests and their contents. But where the plan of destroying the caterpillars in their webs is adopted, care should be taken that this is done when the caterpillars *are within them*. It should be done on an overcast, wet day, or early or late, and it is best for two people to carry out the work. One man should have a pail with some fluid in it,—water and paraffin, or fluid mud with a little paraffin, or anything, in fact, that will prevent the caterpillars that fall in, rambling away. If the pail is held by one man, so that the web-nest cut off by the other falls into it, this is an excellent remedy for such part of the attack as may be in reach. In any case, measures should be taken to prevent stray caterpillars returning up the stem of the tree to the leafage.

A less troublesome but less complete method is to shake the boughs, or strike them smartly, so as to make the caterpillars drop, and sweep those that dangle by their threads in the air down with the hand. These may be trampled on, or gas-lime, quick-lime, or anything that will kill them, may be thrown on them; but it should be done *at once*.

Spraying the infested trees is of service with this as well as with other orchard caterpillar attacks; for observations on which see notes under the head of “Winter Moth”; also references to “Paris-green,” “Soft-soap Washes,” &c., in Index. The Lackey Moths harbour in long grass and leaves on the ground, and, therefore, keeping the trees clear of a *neglected* undergrowth of weeds and rank herbage, such as is too often seen in uncared-for orchards, is a useful measure of prevention.

To what extent birds should be encouraged is a matter for

the consideration of the orchard-grower. It is certain that some of the mainly insectivorous kinds give help by clearing out eggs and small grubs from nooks which can be got at in no other way, and that these should to all reasonable extent be preserved; but at the same time bird presence should by no means be encouraged to such an overwhelming extent that they demolish the very crops they were meant to protect.

In the case of Lackey Moth, a special word may be said for the Cuckoo as a helper, as this bird in adult state feeds especially on hairy caterpillars.*

Lappet Moth. *Gastropacha quercifolia*, Linn.



GASTROPACHA QUERCIFOLIA.—Lappet Moth (the larger the female, the smaller the male); also caterpillar, and Apple-twig with leaves eaten away. All from life.

* See Yarrell's 'British Birds,' vol. ii.; and Macgillivray's 'History of British Birds,' vol. iii.

The attack of the Lappet Caterpillars to orchard leafage has very rarely been reported as occurring to an injurious extent with us, and here, as well as on the Continent of Europe (where the attack is much more destructive), it is rather from the great size of the caterpillars than from their numbers that they are seriously mischievous; still, as, when they do occur, they have a capacity of wholly destroying every leaf that they come across down to the very footstalk (as shown in the figure, p. 24), a few notes taken from observations sent me from presence of the attack on Apple in the neighbourhood of Hereford in the years 1893 and 1894, may be of useful interest.

The caterpillars of this "Lappet Moth" grow to a length of from four to five inches (one specimen sent me was somewhat over four inches long), and are cylindrical, slightly hairy, and grey or brownish in colour, but the tint is variable, and so also is the pattern of the markings down the middle of the back. These may be almost absent, or may occur as a row of somewhat V-shaped dark marks; but across the back, on the segments next the head, are two beautifully lustrous, deep blue or purple velvety bands. These are characteristic markings, and are especially observable when the caterpillar is in movement; when at rest they may be hardly noticeable. The caterpillars have three pairs of claw-feet, and four pairs of sucker-feet beneath the body, besides the pair at the end of the tail; and just above the feet, and all along each side is a row of fleshy warts or appendages with long grey hairs, to which the name of "lappets" has been given, whence the name of "Lappet Moth." These "lappets" show clearly on the segments not furnished with feet or with sucker-feet, but they are so often not clearly represented, especially above the sucker-feet, that much care has been taken to give them distinctly in the figure, p. 24.

When full-grown, which may be in the late spring or early summer, the caterpillar spins a dark-coloured oval cocoon, apparently in any convenient shelter, as the localities are variously recorded as being in clefts of bark, or between boards under eaves, or amongst the lower twigs of the plant on which the caterpillar fed, or close to the ground amongst grass.

From these cocoons the moths appear at variable dates from June to July and August, or sometimes even as early as May. The moths vary a good deal in size; the females being sometimes as much as three inches and a quarter in the spread of the fore wings, whilst the male, as in the specimen before me, may be no more than two. The colours are rich brown, marked transversely on the fore wings with irregularly disposed dark scalloped lines; the hinder wings are somewhat

similarly marked, and the hinder margins of both wings scalloped or indented at the edge. When at rest, the fore edge of the hind wings, which is somewhat dilated, projects so as to be very noticeable beyond, and from under the fore edge of the fore wing, thus giving an appearance much like a dead brown leaf to the moth, which probably often secures it from observation, and from which it takes its specific name of *quercifolia*, or oak-leaf.

The early history of the caterpillars is recorded as being hatched in September, and moulting once, and spending the winter extended on a twig of their food-plant, and in the following season completing their growth; and in the observations sent me from near Hereford it was mentioned: "Our fruit foreman thinks that the grubs are hatched in the autumn, for young caterpillars are found on the bark very early in the spring."

The first notes which were sent of the infestation (on the 8th of May) were accompanied by a fine nearly full-grown specimen of the caterpillar more than four inches long; and on the 10th of May in the following year (1894) a consignment of more than a dozen of the grubs was sent me from the same locality, ranging from an inch and a quarter to two inches and a quarter in length, but mostly of the larger size, and of a greyish ground colour. Two or three were of a smaller size, and these were of a rich brown ground colour.

My correspondents informed me that they had not discovered the attack on their trees until the spring of 1893, nor was it found in any considerable quantity; but where it was found, every leaf was devoured. A few specimen branches were sent to me to show the extent of the damage, and these I found, as described, absolutely cleared of leaves, excepting that in a few instances some small remains of young leafage in very miserable condition were still existing, these being almost entirely at the ends of the twigs. For the most part all had been thoroughly cleared down (as shown in the figure, p. 24) to a mere stump of even the leaf-stalk. The Apple-shoots forwarded were from about twelve to seventeen inches long, and of various ages up to young boughs of from three-eighths to half an inch diameter.

In this country the attack has been recorded as occurring on Willow, also Sloe or Blackthorn, and sometimes as being found on Pear, and also on Whitethorn. On the Continent it is known to be often injurious to young Plum trees, and also Apple, Pear, and Peach trees; but (as before mentioned) more from the great size than from the numbers of the caterpillars.

Under the circumstances, the surest method of getting rid

of the infestation is in all probability *hand-picking*. The thorough destruction of leafage is a guide to where to look for the cause, and the size of the caterpillars makes them observable. From the rarity of the attack and the beauty of the specimens they are often welcome additions to the collections of amateur entomologists or to "naturalists" for sale, and a hint of the presence of the attack in an appropriate neighbouring quarter might very likely bring a thorough clearance without any expense to owner of the infested trees.

Small Ermine Moth.

Hyponomeuta padellus, Linn.; *H. variabilis*, Zell.



HYPONOMEUTA PADELLUS.—Small Ermine Apple Moth, caterpillar, and cocoons, life size; and caterpillar, much magnified.

The presence of this infestation on orchard or garden fruit trees is as observable as that of the Lackey Moth from the similar habit of the caterpillars of living together in large numbers and spinning web-nests as a kind of family shelter, and the same kind of treatment is applicable to each attack.

In 1888 caterpillars of the Small Ermine Moths swarmed to such an extent on the trees in the Fruit Grounds at Toddington, in Gloucestershire, that in the early part of the summer Capt. Corbett (the Superintendent) wrote me they collected the cocoons by bucketfuls; and the same kind of caterpillars also did much injury in that year to orchards in Herefordshire, some trees being completely stripped.

The moth lays her eggs in roundish patches on the small twigs, and covers these patches with a kind of strong gum, which is yellow at first, but gradually changes to a dark brown, so as not to be easily distinguishable from the brown twigs. The eggs may be found hatched by the beginning of October, but the caterpillars (which are then little yellow creatures with black heads, and only about half a line long)

remain sheltered under the patch of gum during the winter, and do not come out till the leaves begin to unfold in spring. Then it is stated (see 'Trans. Ent. Soc. Lond.,' vol. i. p. 22) that they burrow into the young leaves and feed on the soft matter within, until they are strong enough to eat straightforward at the whole leaf, when they come out from their workings and thus make their appearance suddenly in large numbers where none have been noticeable just before. This part of the attack I have never myself seen, but (without going into minute details of their earliest life) in the spring or early summer the caterpillars appear on the leafage of the attacked trees, and these continue feeding on the leaves and spinning webs, in which they live together in large companies, until, in severe attacks, the hedge or tree infested is stripped of its foliage, and left hung over with a kind of sheeting of the dirty ragged remains of their deserted webs.

When full-fed each caterpillar spins a light cocoon, in which it changes to the chrysalis *inside the general web*. The Small Ermine Moth caterpillars are of a dirty ash or ashy white colour, spotted with black; when full-grown, the ground colour is dirty yellow or lead-colour.

The moths, which come out towards the end of June, are about three-quarters of an inch in expanse. The fore wings are usually livid or whitish, dotted with black; the hind wings livid or lead-colour; but they are very variable.

The kind or variety figured (p. 27), of which the moths are distinguishable by the fore wings having the black spots on a pure white ground, and by the cocoons being opaque, was at one time considered more especially to frequent the Apple, and was especially distinguished as *Hyponomeuta malivorella*, or "Small Apple Ermine Moth"; but for all practical purposes the treatment of the attacks (whether there may be a slight difference in the nature of the "Small Ermines" or not) may be considered together.

PREVENTION AND REMEDIES.—As the caterpillars of this moth turn to chrysalids in cocoons in their large nests or masses of web, the simplest method of prevention of future attack is to *cut off these webs* and destroy them with the cocoons within; also, in an earlier stage, if the web-nests, full of caterpillars, can be cut off into a pail of anything that will destroy them (as recommended with regard to Lackey Moth), or if they can be shaken down and destroyed, this is very desirable; but where the ragged webs and small parties of caterpillars are widely distributed over a tree, it is very difficult to manage these arrangements. Where a party of caterpillars are collected together on a bough where the mass

can be grasped in the hand and thoroughly squeezed, this will get rid of many very surely and easily.

I have found it answer very well, where there was a good water supply laid on, to *wash the infested tree* well down with a strong current of water sent through a hose. From the clinging nature of the web the operation took some time to carry out completely, but I have myself thus cleared and cleaned a tree very satisfactorily.

The various washings recommended for remedy of Lackey Moth attack would be as serviceable for that of the Small Ermines, and in both cases good *drenchings of soft-soap*, mixed as thickly as it could be applied (with a little paraffin added), well syringed at each web-nest, would have a very good effect.

It has been observed that the whole brood of moths usually hatch from the chrysalis at the same time, when their light colour makes them easily seen, and they are sluggish by day; it has therefore been found useful to spread a sheet under the trees, and by beating or *shaking the boughs* make the moths fall into the sheet, and destroy them.

Garden Chafer; Rose Beetle.

Phyllopertha horticola, Linn.; *Anisoplia horticola*, Curtis.



PHYLLOPERTHA HORTICOLA.—Beetle, natural size (walking), magnified (flying); grub, also magnified.

The “Garden” or “Rose” Chafer has long been remarkable for appearing in great numbers occasionally, and doing much mischief in beetle state to tree leafage, and also, when in maggot condition, by feeding at the roots of grass, and so far back as 1844 John Curtis gave dates of some of their great appearances.* The earliest noted was in 1814, “in immense numbers,” near Swansea. In 1832 Apple and

* See ‘Gardeners’ Chronicle,’ vol. iv. p. 700; Curtis, ‘Farm Insects,’ pp. 219–222, and p. 509; also Curtis, ‘Brit. Ent.,’ fol. 526.

Nectarine trees were very seriously injured; in 1833 Roses were especially noticed as attacked; young Apple trees are noticed as being occasionally defoliated by them, and at another time (of which I have not the date, but prior to 1844) the Chafers are noted by Curtis as being "so abundant on the Acacias, near Petersfield, as to consume the foliage, and when the trees were shaken they fell down like a shower of hail." 1839 and 1840 are mentioned as years in which the maggots were especially abundant in autumn in Hants and Gloucestershire, and this great presence of maggots happened also in 1844 in different localities; but from 1877—the date of commencement of my series of Annual Reports—until the year 1892, I am only aware of one note of observation of presence of this chafer to any remarkable amount being sent me, namely, on the 18th of July, 1885 (when the beetles were noticed flying in thousands over the field at a locality near Nantwich, in Cheshire), but since 1892 the infestation has been only too frequently injurious, both in grub and beetle state.

Amongst orchard fruit trees the Rose Chafers are particularly hurtful to Apples, of which they greatly injure the leafage, in some years, and also feed on the very young fruit, and the leafage of Nut bushes is also attacked by them. In 1892 information was sent me of Apple trees near Abergavenny being much infested by this beetle, known there as the "Button Fly"; and in their outbreak at Haslemere (Surrey) in the same year it was noted that this "Rose Chafer" badly attacked Apples, Cherries, and Plums. The Apples were especially injured, the remnants of leaves left on looking as though they were scorched; many of the young Apples were also destroyed. The whole Cherry crop was consumed. In 1893 notes were sent (amongst other observations) of the beetles being on the lawns, meadows, and fruit plantations at a locality near Sevenoaks, Kent, "in greater numbers than before"; and in 1896 a correspondent at Shottermill, Surrey, reported "great harm to the few Apples and Pears which the Winter Moth caterpillars had missed when the fruit trees had been stripped bare earlier in the year."

Taking the above notes together, it will be seen that the Rose Chafer beetles are injurious to the leafage of Apples and Pears, also of Plums and Nuts, and as the whole Cherry crop was noted as being consumed, it appears that the chafers devour this fruit as well as young Apples. Roses we are well aware they are excessively mischievous to.

In the larval or maggot condition this infestation does widespread and serious mischief by feeding at the roots of

grass in parks and pastures, and in orchards, and on ornamental lawns, also at the roots of corn and a variety of crops, and though with care and knowledge something may be done towards getting rid of the beetles, yet any means of destroying the maggots without also destroying the grass, at the roots of which they harbour, are (so far as we know at present) next to impossible to carry out.

The Rose Chafer grubs are very like those of the Cockchafer in appearance, though much smaller, and (like them) when at rest they lie for the most part on their sides, with the head and tail curved towards each other (see figure, p. 29). They are whitish or somewhat yellowish in colour, and fleshy, with chestnut or ochreous-coloured head, furnished with somewhat rusty-coloured jaws, darker at the tips, and have a pair of moderately long legs on each of the three segments immediately succeeding the head, and the hinder extremity of the body is somewhat swelled, and has the appearance of being of a lead colour, from the food within showing through the skin.

When disturbed the maggots can straighten themselves, and use their legs for walking with some rapidity, and creep along (when I have timed the rate of progress by the seconds-hand of my watch) at from five to six inches in about half a minute. From the very great resemblance of this maggot to that of the Cockchafer (*Melolontha vulgaris*) there is difficulty in distinguishing between the two kinds whilst they are still of the same size; afterwards, as the Cockchafer grub grows to fully four times the size of that of the Rose Chafer, the distinction is plain. For those, however, who wish to be able to identify the two kinds of larvæ with certainty for scientific purposes, the fullest descriptions are available in the work 'De Metamorphosi Eleutheratorum Observationes,' by I. Schiodte, from which, through the kind assistance of Mr. W. Hatchett Jackson, M.A., of Keble College, Oxford, who was good enough to translate and tabulate the distinctive points for me, I give below the differences between the two kinds of larvæ.*

* "*Larva of Phyllopertha horticola*.—Vertical suture of head a very fine line. Epistoma broader by half than it is long. Third joint of antennæ of same length as the first joint. Tibiæ of legs twice as short as femora. Claws of legs increasing in size in the successive pairs. Abdomen cylindrical though somewhat clavate. Anal valves obscurely marked off; lunate in shape. Spiracles orbicular.

"*Larva of Melolontha vulgaris*.—Vertical suture of head deeply countersunk for a short space behind the epistoma, its margins somewhat raised. Epistoma three times as broad as long. Third joint of antennæ nearly one-third shorter than first joint. Tibiæ of legs one-fourth shorter than femora. Claws of legs diminishing very greatly in size in successive pairs, most markedly and abruptly in those of third pair. Abdomen clavate. Anal valves sharply marked off; upper valve triangular, lower valve trilobed. Anterior spiracles short ovate, posterior orbicular."

Their favourite feeding-ground is, as previously mentioned, at the roots of grass in pastures, and they also attack the roots of various kinds of corn and of Clover, and have been known to attack Mustard. Amongst garden crops they do not except different kinds of Cabbage; and amongst harder rooted plants they are injurious to Rose roots, and have even been found at Pine roots. They are stated to lie customarily about an inch below the surface, but when autumn cold comes on, or when they are about to turn to pupal state, they go down deeper.

The mischief caused by the feeding of the grubs beneath the turf may continue certainly up to the middle of October, and presumably (weather permitting) to a later date. In some observations which Mr. T. P. Newman was good enough to make at my request as to whether the grubs were still to be found in the middle of October, he wrote to me, from Hazelhurst, Haslemere, Surrey, on the 14th of October, 1893, that in the spaces of ground that he examined, the top three inches contained no grubs at all. Between three inches and six there were few. Below six inches and down to nine inches they were plentiful. Below nine inches down to twelve there were few; and below twelve inches there was little but stone and shale, and there were no grubs. This depth obviously gives a most safe resting-place from all but stringent mechanical measures.

The grubs turn to a pale-coloured chrysalis in an earth-cell in the ground, from which the beetles make their appearance in the following summer.

The beetles, or "Rose Chafers," are of the size of that figured in the act of walking at p. 29. The head and fore body are of a glossy bright or dark green, sometimes with a violet tinge on the under side; the legs greenish black, and the wing-cases bright chestnut; the antennæ, or horns, rusty or chestnut-coloured, ending in a three-leaved club or fan of a pitchy colour.

The beetles appear in May and June,—I believe the earliest precise note that I have had of their appearance in large numbers was on the 23rd of May,—and each female is considered to lay about a hundred eggs in the ground. The whole duration of life from egg deposit in one year to beetle development in the next is not more than twelve months.

PREVENTION AND REMEDIES.—The simplest and best remedy turns on the flight time of these Garden or Rose Chafers being in the sunshine, or heat of the day. This is noticed in German preventive observation. Dr. Taschenberg observes, with regard to beating them down, that in this operation it is

to be borne in mind that these little Garden Chafers are more active than the Cockchafers, and fly about freely in the sunshine.

The German method of collecting is to beat or shake them down at whatever time they are found to be most torpid (whether in the evening, or in the cool early morning hours) on to cloths, or sheets, or anything spread below the boughs which will allow of shaking the beetles together and destroying them. An inverted umbrella is particularly mentioned as a convenient receptacle. This would be useful on a small scale of working, as for Roses or the like; probably in orchard work the attendance of the pigs, which are invaluable in similar operations with Cockchafers, would be also useful here, and might save the trouble of spreading anything beneath the trees to collect into. But whatever method is followed in the detail of beating down, the important point is that it should be done when the beetles are torpid.

For the following note of great presence of the Rose Chafers having occurred for a few days, and of the simple method used to get rid of them, I am indebted to Mr. T. P. Newman, of Hazelhurst, Haslemere. Writing on the 20th of September, Mr. Newman mentioned:—"They swarmed with me for two or three days only; we did nothing by day, but acted on your hint at dusk; put sheets under the fruit trees, shook the latter, and picked up hundreds of the beetles, which made no attempt to escape, and destroyed them in hot water. They attack the Scotch and Austrian briars much more than any other Roses."

Another correspondent, writing from a much infested locality, mentioned that he noticed that "these beetles never fly when the temperature is low, or in the evening. When the sun goes down you can shake them off the trees easily." "But," it was also noted, "unless you put a sheet underneath the trees, you would never find them, as they seem to disappear the moment they touch the ground."

Yet another observer mentioned:—"We gathered in some hour and a half (by shaking the fruit trees over a sheet, rolling it up, and shaking the beetles into a stable bucket) more than half a bucket of solid beetles. These and most others, after scalding, we gave to our fowls."

But whether by means of shaking down, or on a small scale, as with Roses, even hand-picking, the only remedial course with regard to the beetles seems to be clearing them from the infested leafage so that there shall be no chance of their conveying themselves back again; and where it may be impossible (as in clearing hedges, which are sometimes very

much infested) to spread cloths below, the help of fowls or young pigs might prove serviceable.

The observer quoted immediately above, mentioned :—"At the height of the season I cut off the heads of Roses in which were several beetles, and took the flowers and contents to a family of young pigs. It was amusing to see the pleasure and excitement of the hunt for the living beetles. I shall, if I can manage it, place our pigs in the field from which the beetles rise next year, and enlist them in the service. If I can find grubs underground, I shall try turning the pigs (without rings) into that infested patch, and letting them turn it up."—(A. L. B.)

For destruction of maggots in the ground it has been stated that to water the infested land in autumn with gas liquor diluted in the proportion of one-tenth of gas liquor to nine-tenths of water does good by killing the grubs without hurting the grass. But it would be eminently desirable to experiment on a small scale before risking a general application. For one thing the strength of gas-water might vary, and it is very difficult to manage fluid dressings so that they should kill the grubs at an inch or two deep in the ground, and yet not hurt the grass.

A correspondent mentioned that rolling with the "heaviest roller" had the effect of hindering the progress of the grubs very much, but the Rye had been bitten off by them in such large patches that it had become necessary to plough up the crop and re-sow.

Another correspondent mentioned that in the case of soot being spread over a piece of ground which had been infested whilst the beetles were flying, that in the following year the grass was greatly improved, and it was considered that the soot drove away the chafers, and prevented them laying their eggs.

Birds of various kinds—as rooks, thrushes, blackbirds, and especially starlings—have been found to be of great use in keeping the grubs in check, and should on no account be driven away. In one locality it was observed that "large flocks of starlings, numbering several hundreds in a flock, frequent the fields where these grubs abound, and the soil is perforated by the birds' beaks." From another locality where the *Phyllopertha* had been very prevalent it was reported that "thousands of starlings are at work in the pasture fields pulling up the dead grass and turning it off to get at the fat succulent grubs, and the thrushes are going the same good work on the lawns.

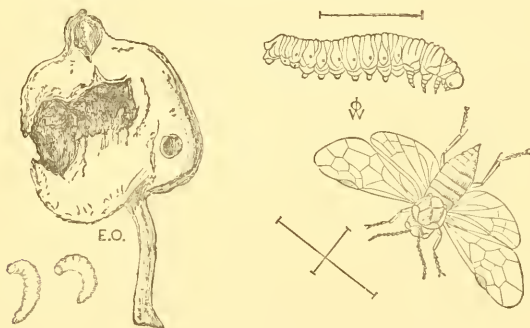
But we still are in great need of more information as to how to cope with these maggots, and even from the United

States of America, from which we gain constant help in methods of keeping injurious insects in check, the most recent information regarding a beetle very similar in its habits only gives us the following from the well-experienced writer:—

“Frequent rotation and fall [autumn] ploughing are to be recommended; and where grass-lands are infested, heavy top-dressings of kainite and nitrate of soda have proved beneficial. Wherever ploughing is done in infested fields, chickens should be encouraged to follow in the furrow, and pick up the grubs.”—‘Economic Entomology,’ by John B. Smith, Sc.D., Professor of Entomology, Rutgers’ College (J. B. Lippincott Company, Philadelphia, 1896).

Apple Sawfly.

Hoplocampa testudinea, Cameron; *Tenthredo testudinea*, Klug.



HOPLOCAMPA TESTUDINEA.—Female sawfly and caterpillar, magnified, with lines showing natural size, after Prof. J. O. Westwood. Injured Apple and caterpillar, natural size.

Apple Sawfly attack has long been known to be present in this country. So far back as 1847 this infestation was described, from his own observations, by Prof. J. O. Westwood; but it was not until the summer of the year 1891 that communications were sent me regarding it as an injurious attack, and I had an opportunity of observing the method of attack myself.

The sawfly (figured above, magnified) is about a quarter of an inch in length; the body is yellow or reddish yellow on the under side; a large patch on the top of the head, also the top of the body between the wings, black, shining, and minutely punctured; the back of the abdomen also black. The shoulders, legs, front and sides of head, and the antennæ (or

horns) yellowish, some of the middle or lower joints of the antennæ being partially marked with brown above. The wings transparent, with veins dark, or darker towards the base, and the stigma (or patch on the front edge of the fore wing) dark but paler, or yellowish at the end nearest the tip of the wing.

The sawflies appear with the Apple blossoms, and the females may then be seen on the wing amongst the flowers, and may be caught in the act of egg-laying within them, the exact spot for deposit (in instances recorded) being just below the calyx. In a series of special observations of the habits of these flies, in which they were first noticed on the 14th of May, the caterpillars were found to be hatching out on the 28th of the same month.

The maggots are pale in colour, and when quite young, that is, when still only about an eighth of an inch in length, the head, and also the plate above the tail, is dark or black; but presently these are moulted off, and when the caterpillars are full grown, that is, about half an inch in length, they are mottled or creamy in colour, with the head pale chestnut, and the plate above the tail and the cross-band immediately preceding mottled with grey, and the three first segments have each a pair of claw or jointed legs. The next segment is legless; and then comes the marked distinction between these caterpillars and those of the Codlin Moth, which otherwise much resemble them. The fifth to the tenth segments of the sawfly caterpillars have each a pair of sucker-feet, making six pairs in all, so that with the pair at the end of the tail (which is possessed by the Codlin Moth also), the sawfly caterpillar has twenty feet in all, whilst the Codlin Moth caterpillar has only sixteen. A comparison of the figures of the two caterpillars (see pp. 9 and 35) will show this distinction clearly, and be an important help towards ascertaining which kind of infestation is present.

The history of the attack of the sawfly, given shortly, is that the caterpillars hatch in the very young (embryo) Apple, and as this grows they grow and feed within, and thereby cause much damage (see figure), not only to the fruits in which they were hatched, but sometimes to other neighbouring fruits, to which they have the power of straying at pleasure. The injured Apples are not so regularly tunnelled as in the case of damage from Codlin Moth caterpillars. There are, or may be, tunnels, but also (see figure, p. 35) much of the inside of the little Apple may be eaten away, thus causing a rough blackened cavity, with decaying surface.

Consequently on the internal injury the growth of the Apple is checked, and it drops; and attention is drawn (as also in

the case of Codlin Moth) to where infestation is present by the numbers of little Apples which have fallen beneath the tree. The sawfly grubs fall to the ground in the infested fruit in June or July, or as soon as the little Apples are so much injured within that they can no longer adhere to the tree; and the sawfly caterpillars then make their way out, to go through their changes in the ground. There they form their cocoons, and remain inactive until the following year, when in May the perfect sawflies make their appearance from the buried chrysalids.

There does not appear to be any record of the caterpillars crawling down the stem of the tree to bury themselves, nor is there (so far as I am aware) any *evidence* of their dropping from the Apples. But still, as in experiment they have been found to drop (when released from the fruit) from a considerable height without injury, and as many recently infested Apples are to be found on the trees without caterpillars within, it is presumable that some proportion of the grubs reach the ground by simply dropping themselves down.

In regard to the depth to which the caterpillars go down into the ground to form their cocoons, this varies according to the nature of the soil. In special experiment made on this subject four inches was the depth at which the cocoons were chiefly found. The first cocoon lay at a depth of two inches, more were found at three inches, and they lay thickly at a depth of four inches.* The cocoons, which are in shape like little balls, and just large enough to hold the caterpillar, may be found formed about a month after the caterpillars have left the Apples, possibly sooner. The caterpillar, however, may be found unchanged within the cocoon, even after the time of Apple blossom in the following year, when the chief attack takes place, the stray flies which then appear presumably depositing on the young Apples when somewhat advanced beyond their quite embryo state.

PREVENTION AND REMEDIES.—All measures, firstly, to keep the infestation from going down into the ground in caterpillar condition, and next to prevent it coming up in winged form, are most important.

In the first case, the little Apples should be collected as soon after they have fallen as possible, and *burnt*. It is little or no use throwing them to a rubbish-heap, from which (unless specially treated) the sawflies would probably fly at Apple-blossom time in the following year to start infestation

* Detailed observations of Life-history of the Apple Sawfly, by Mr. W. Coleman, of Cranford, Newport Pagnell, Beds, will be found in my Fifteenth and Sixteenth Annual Reports of Injurious Insects.—E A. O.

anew. Where there is much mischief going on it would be worth while to spread rough cloths beneath the Apple trees, and jar the boughs well so as to cause the injured fruit to fall, which thus might be easily collected and destroyed before the caterpillars had a chance of escaping into the ground.

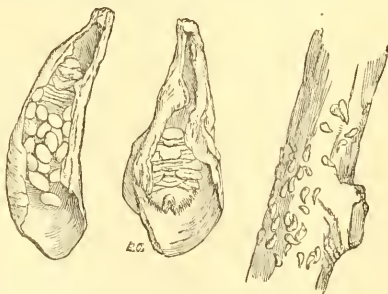
Where the Apple roots are not so close to the surface as to make skimming off the surface injurious to the tree, it is a sure way of preventing much recurrence of attack to find by examination how deep down the little ball-like cocoons lie, and then to remove the soil to this depth, and bury it *deeply* down, or throw it on rubbish fires. Even stirring the soil sometimes is beneficial, and the ordinary preventive dressings would presumably be beneficial.

Whilst attack is going on (the sawfly being quite of a noticeable size) many of the insects may be killed on the blossoms by hand-picking, where the trees are either espaliers or low enough to bring them within reach. Where they are taller, spraying might be used, presumably with just as good effect as in the case of Codlin Moth, for observations on which see page 14.

It also would help much in success of preventive treatment if a few of the fallen Apples were split open, and the owner would examine whether the appearance of the *damage* within pointed to the attack being that of Codlin Moth or Sawfly caterpillars; and make still surer by finding, with the help of a hand magnifier, which kind of caterpillar was present. In the case of Codlin Moth attack, it is waste labour to remove the soil; in the case of sawfly attack it is equally labour lost to scrape and clean chrysalids from crevices in the bark.

Mussel Scale (Oyster-shell Scale, U.S.A.).

Mytilaspis pomorum, Bouché; *Aspidiotus conchiformis*, Curtis.



MYTILASPIS POMORUM. — Female Scales showing female and eggs; and also female shrivelled within the Scale, much magnified. Infested Apple twig.

This species of Scale insect, which may be found at times so thickly coating moderately young bark of the stem and branches of the Apple tree as almost to cover the surface, takes its popular English name with us from its resemblance in shape to our common mussel-shells. In America and elsewhere it is known as the "Oyster-shell" Scale, or "Bark-louse," similarly on account of its resemblance to the shape of an American species of oyster.

It is very widely distributed, being found in Europe and North America, New Zealand, &c., and infests many kinds of trees and shrubs; and amongst orchard trees and fruit bushes is to be found on Apple, Pear, Plum, Peach, Apricot, and Currant; but with us it is a special infestation of Apple bark.

The injury is caused by the little *Cocci*, or scale insects, whilst still in active life, inserting their suckers, or proboscis, into the tender bark or young shoots, and thus sucking away the juices, and also doing harm to the tissues by the number of punctures.

The shape of the larval scale insects when hatched is of a lengthened oval, with a spine at each segment, and at the abdominal extremity two long silky appendages, and at each side two lobes; and the antennæ (or horns) are of noticeable length.* They are furnished with eyes, six legs, and a sucker, and run about with great activity for a few days, and then fix themselves, increase in size, and change to the pupal state, in which they are known as "scales."

These scales are not the true insects, but are shields, or *puparia*, composed partly of fibrous secretion, partly of the thrown-off insect-skins, and differ slightly in the male and female form.

The female scales are about the tenth to the eighth of an inch long, usually brown, but sometimes ash-grey or even white, of the shape as figured above by myself from English specimens, elongate, slightly curved, and widened posteriorly, much smaller and of a rusty colour at the other end. The male scales are smaller than those of the female, and straight, or nearly so.

For the most part the scales adhere firmly to the bark of the infested tree, and on lifting full-grown female specimens the female itself will be found inside, towards the smaller end of the scale (sheltered by it, *not* fastened to it), the larger end of the scale being filled with fifty or more white oval-shaped eggs. The female resembles a flat fleshy maggot of a pale greyish or yellowish colour, elongate or globular, or, as egg-

* See "Essai sur les Cochenilles," collective edit. from 'Annales de la Soc. Ent. de France,' par Dr. Signoret, vol. i. p. 98 (142).

deposit proceeds, somewhat flattened, and with lines across showing a division into rings, that is, segmented, each segment having on each side two or three strong spines. Abdomen ending in two large lobes, with two others much smaller on each side; middle lobes trifoliated. After depositing her eggs she dies, and may be found shrivelled inside the scale.



Male of *Mytilaspis pomorum*, much magnified.

The male (see figure)* differs entirely from the female in being active, having six long legs, and a pair of wings; the colour is described by Prof. C. V. Riley as a "translucent corneous grey," with some portions of the fore body darker, and the legs lighter.

In the United States there is only one yearly brood in the northern parts, but two in the warmer parts; with us, so far as I am aware, there is only one generation in the course of the year, of which the young insects appear in May, when they creep out from under the old dead scales and begin attack.

PREVENTION AND REMEDIES.—Scale may be removed at any time of the year, but the best season for destroying it or applying dressings is in spring, so as to clear it away before the young insects which creep out in May, as above mentioned, have spread themselves abroad.

It may be removed by thoroughly moistening the surface of the infested bark with lathers of any kind of soap (or any dressing that may be preferred), and then scraping the surface with a blunt knife, or rubbing it with pieces of coarse canvas, or well brushing it, so as to clear off the scale without hurting the bark.

Scraping with a blunt knife is a good plan, as in this way the scales, moss, and everything on the surface are mixed up in a plaster with the soapy lather, and got thoroughly rid of together; if brushing is preferred, good drenchings of soap and water, or of dressings poisonous to the scale, should be

* Reduced from figure in 'Economic Entomology,' by Prof. J. B. Smith. Philadelphia: J. B. Lippincott Co., 1896, p. 115.

given in addition to the first thorough moistening, so as to wash down or kill all that may have only been disturbed or may be lodged in crevices.

Soft-soap or common coarse household soap are useful for this purpose, and the following recipes for dressings are mentioned as having been found serviceable, and might be varied, in proportion of the ingredients, as thought fit.

One ounce of soft-soap, one pound of tobacco-paper, and four handfuls of sulphur to one gallon of water ; this is to be applied with a painter's brush, taking care to rub thoroughly ; use plenty of the liquid, and flood every part of the tree. Three applications in this way are stated to have been always found a complete cure.

As a means of clearing the scale out of crevices, it is advised to scrub the trees well at the proper season (that is, during April or early in May) with soft-soap and water, and then brush them over with the following mixture :—Two pounds of soft-soap and one pound of flour of sulphur, well mixed in about fourteen gallons of water.

The following mixture has been found serviceable in destroying scale insects, Thrips, and other plant-vermin :—One hogshead of lime-water (use half a bushel of lime to this quantity of water) ; add four pounds of flour of sulphur, six quarts of tobacco-water, and four pounds of soft-soap. This mixture is to be well stirred and incorporated together, and applied by dipping the infested boughs or by syringing. The composition may be allowed to dry and remain on for about a week or ten days, when it may be washed off with clear water.

It is also said to answer to get some tenacious clay, dilute it with water to about the consistency of paint, and to every gallon of this add half a pound of sulphur ; mix them well, and paint the trees all over. It is advised to apply two dressings of this, allowing the first to be thoroughly dry before the second is put on. It requires a fortnight to kill the scale by this application, and when the clay drops off it will bring the scale with it.

The following notes (though not referring to this species), taken from Prof. J. B. Smith's excellent work, mentioned in note, p. 40, give good advice as to the importance of applying treatment in good time, before the active larvæ have settled down for pupation under the protection of a thoroughly formed scale. The passage is as follows :—

“Where winter treatment is inadvisable or impossible, applications should be made when the larvæ emerge from the eggs, and before they fasten themselves to leaves or twigs. There is no difficulty in killing the young with either soap-

suds or kerosine emulsion, but—and here is the important point—the application must be made before the insect is protected by a scale, or when the scale is yet very thin and newly formed.”

In the case referred to it is said that kerosine will not certainly kill the eggs, “yet if soap-suds be used to dilute the emulsion, the . . . mass will be so impregnated with the soap, and become so compact, that the young will be unable to make their way out. . . . In this case dilute three quarts of kerosine emulsion with one pound of whale-oil soap dissolved in eight gallons of water.”

The above recipes, though not especially advised as treatment for the Apple Scale, would probably be very beneficial, and mention of several serviceable applications will be found in the paper on “Currant and Gooseberry Scale.”

Apple-suckers, or Apple Chermes.

Psylla mali, Schmidberger.



PSYLLA MALI.—Apple-suckers, from life; nat. length, one-twelfth of an inch.
Pupa of Pear-sucker, also magnified (after Prof. W. Saunders).

The minute insects figured above, which are hardly an eighth of an inch in length from the head to the tip of the transparent wings, and are usually of a beautiful bright green colour, sometimes do great mischief by sucking away the juices of the young Apple buds, and later on in the spring by similarly sucking away the juices of the stalks of the blossom or blossom-buds.

The figure above shows this Chermes, or Apple-sucker, greatly magnified, with its wings spread, and also with them raised in act of taking flight. The figure of the pupa is added to give a general idea of its appearance, from that of the very nearly allied species, the Pear-sucker, as I had not a specimen of the *P. mali* in this stage at hand.

The life-history of the infestation (beginning the observations in September) is that when the Apple leafage begins to turn yellow the Apple-suckers may then be found in little parties of five or six on a leaf, especially on a yellowing leaf; and at this time of pairing both the German and our own observations show that the little insects assume most varied colours; some may be red, some quite green, and some milky white; others may be green with yellowish patches on the fore body and paler lines on the abdomen, or green with patches of a reddish tint, or pale yellowish with a red or brown tint running all along the top of the insect.

After pairing the females leave the foliage, and lay their white spindle-shaped eggs singly or several together, or sometimes in rows. These are placed in various parts of the tree, and (where I have seen them) in furrows, or in protective hollows near the end of shoots. They are also recorded as being laid on year-old shoots where there is fine hair. In the specimens sent me, although most of the eggs were whitish and spindle-shaped, some were more obtuse and yellower, and in a length of about an inch of shoot I counted approximately upwards of fourteen eggs.

The eggs hatch early in April, and the young Apple-suckers, which much resemble their parents in shape, excepting in being quite wingless, and are of a dirty yellowish colour with brown abdomen, at once begin to feed, and are especially noticed as gnawing a way for themselves into the nearest buds, so as to shelter themselves from cold and wet. After moulting for the first time the larva protrudes a small white globule, which remains attached by a white thread to the body, and in case of this being removed, another ball and thread is produced. At the second moult a much larger number of threads are produced, forming altogether an entangled mass, with which the larva covers up its head and body. Later on the larva assumes the pupal state, in which the rudiments of the wings are visible (as shown in the figure of the Pear *Psylla*, p. 42), and from this the perfect insect appears at some time from the earlier part of May to the beginning of June. If the little insects are observed through a magnifying-glass, it will be seen that they can run well, and then with a sudden skip fly away; also that the eyes are in some instances very peculiar, being white with a central black spot, which gives the appearance of their having a black pupil.

Amongst various observations sent me in the year 1890 regarding the habits of this insect from the orchard-growing districts near Pershore and Redditch, it was mentioned as one which, although "almost unrecognised and certainly little

mentioned," was the cause of great destruction to the Apple crop, and it was remarked :—"The presence of the *Psylla* on the Apple is always indicated by small opaque saccharine globules (vulgarly named 'honeydew') in and about the stalks of unopened flower-buds; and if such a sprout be plucked apart, the young, flat, inert, wingless insect will be found in numbers sucking the juices of the stems of the blossoms. The flower-buds, being deprived of their sap, shrivel up, and no Apples are produced; and the insect, casting its skin, appears in a short time, . . . light green, with transparent wings, active in habit, and leaping all about the tree."

One difference between this and other Apple infestations is that the *Psylla* works so that the mischief may be done before the results are noticeable, at least to a casual observer, the sucking away of the juices sapping the strength of the stems of the blossom-buds, so that, though some may escape, yet the whole cluster of bloom may die without setting fruit. In 1891 notes were sent from near Redditch of this attack so weakening the middle blooms of the trusses, where the "suckers" could shelter themselves from insecticides, that the injured part could be shaken down "like chaff," and the loss was great.

The attack appears to be of only occasional appearance to a serious extent, and has been only specially reported to myself in 1890 and 1891, and again in 1897.

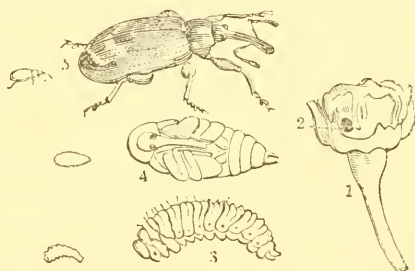
PREVENTION AND REMEDIES.—Many of the eggs which are laid towards the ends of the shoots may be removed by winter pruning, and to save chance of future mischief it would be well to burn the prunings. Insecticides such as are sprayed about flowering time for other attacks would kill the insects which they reached on the trusses, but would need care both in selection and strength of application lest they should do more harm than good by destroying the blossom-bud. Conjecturally soft-soap wash, with some mixture of sulphur or quassia or tobacco, might do good, but the only notes hitherto sent on of trial of insecticides were that they had little effect.

Some good was done in a small scale of growing by shaking shoots with infested trusses over an old umbrella placed wrong way up below, and daubed inside with adhesive mixture. From the habit of the insects of flying out on disturbance, many fall down and are captured. This plan might be used on an enlarged scale by placing tarred cloth beneath the trees and shaking the boughs.

Another method of lessening number of the insects which was found to answer also by Mr. J. Hiam (who has devoted much attention to this infestation) in the neighbourhood of

Redditch, Worcestershire, was to fasten some pieces of flat light tin at the end of a light wooden lath, about four feet in length; this lath being smoothed towards the lower end, so as to allow of it being comfortably grasped. The pieces of tin were well greased with some adhesive mixture, and taking advantage of the *Psyllas* flying off on disturbance, this simple implement was waved to and fro amongst them. The result, as shown by measurement of surface and insects caught to the square inch, was the very great number of five thousand in an hour! Whether it would be so successful in ordinary working hands may be doubtful, still the observation appears worth record, with the note that the operation is said to be most successful in brilliant sunshine.

Apple-blossom Weevil. *Anthonomus pomorum*, Curtis.



ANTHONOMUS POMORUM.—1 and 2, Apple bud pierced by weevil; 3, maggot; 4, pupa; 5, weevil; all magnified, with figures showing natural size.

This is one of the regular old-standing orchard attacks which appear, more or less, every year, and in some years it is very injurious. The amount of harm done in some degree depends on the season, because the beetle does not lay after the flower bud has begun to open, so that in a warm sunny season, when the buds form and open quickly, the female beetle, whose laying operations are slow, has them cut short before completion by the blossom buds having ceased to be in a state for laying in.

The method of life of these weevils is for the female to make a small hole in an *unopened* flower bud by means of little jaws placed at the extremity of the long curved proboscis or snout, with which these “long-nosed weevils” are furnished. She then lays one egg in the hole, and with the help of her proboscis she closes the opening; she then goes on to another bud, and may continue egg-laying for two or three weeks (according to state of the weather) in Apple or

Pear buds. The first appearance of the beetles is recorded as being in March when the flower buds are swelling, and on sunny mornings the beetles may be seen in numbers about the trees. In some of our earlier observations, both British and Continental, of these weevils, it was considered that though the males fly readily, that the females for the most part did not do so, but as a habit crawled up the stem of the tree, or walked from one bud to another. This point is very important relatively to preventive measures, and during the weevil season of 1890, hearing from one of my Kentish observers (on the 2nd of April) that the Apple weevils were "active and plentiful, and it was useless to dress the stems of the trees, as this insect seems to fly as readily as any other,"* I suggested it would be very useful if he would make sure whether specimens which he saw on the wing were females by examining whether they contained eggs; and later on in the month, on the 25th, Mr. H. C. Staples reported to me: "I have killed several with wings, which I have found to contain little creamy-white eggs."

Hatching may take place from the beginning to the end of April, and if the weather is warm the eggs hatch in about six or seven days; and from observations sent me in the same year from various localities on the 2nd, 4th, and 6th of June, the change from maggot to chrysalis state and (on the 6th) to the weevil condition, of which samples were enclosed, was then in progress.

The maggots, which will be found inside the flower buds, on the contents of which they have been feeding, are of the shape figured at p. 45, fleshy, whitish, wrinkled across, somewhat curved, with a few hairs, legless, and with a dark horny head.

Each maggot feeds within its own flower bud, which, therefore, instead of expanding, turns brown, and dies; the maggot turns to an ochry or rusty-coloured chrysalis of the shape of the beetle, only with its limbs still folded beneath it (see figure 4, magnified, p. 45) in the injured bud; and here, under the shelter of the brown unexpanded blossom-leaves the weevils develop from the chrysalids in about a month from the time when the eggs were laid, and disperse themselves over the tree, where they are said to injure the leafage, but the most important damage is that which they cause to the flower buds.

These beetles are of the shape figured, p. 45, of a reddish brown colour, with three indistinct stripes of a paler colour on the body behind the head; the wing-cases have a large

* See my Fourteenth Annual Report on Injurious Insects, p. 12.

pitchy-coloured patch, with a pale oblique stripe on it, and two ochreous spots towards the tip.

They pass the winter in chinks and crannies, or under loose pieces of the bark, or under clods of earth or stones, and come out when the flower buds are swelling in spring, when they may be seen flying round the trees.

PREVENTION AND REMEDIES.—One good method of prevention is to clear away from beneath trees which have been infested rubbish of any kind, such as stones, clods of earth, or bits of wood, which might serve as shelters to the beetles during the winter. It is also desirable to remove rough and useless bark, and to keep stem and branches in such a well-tended condition that there may be as few winter lurking-places for the beetles as possible in crannies or under broken pieces.

Where the bark is clean and in good order there will be few hiding-places on the trees, and it would be of service to syringe a mixture of any deterrent wash that would not hurt the bark or leaves on to the trees when the beetles are beginning to move about in spring. This would lodge in the crannies where the weevils especially hide, and kill them if they were there, or if they were moving about on the boughs would clear many off, and for this purpose soft-soap applications, thick or thin as the case may be, would be very desirable. The weevils fall to the ground on being alarmed, and at egg-laying time many might be shaken down from the trees on to cloths spread below, and thus got rid of at an expense which would certainly be remunerative in garden cultivation, and worth a trial for orchard ground in cases where seriously bad attack was known to be going on.

The plan of getting rid of the pest "wholesale," as may be done by shaking the infested buds down at the date when they are so far destroyed as to fall to jarring might, I believe, be followed up advantageously to a much greater extent than at present. We have found by experiment that early in June many of the infested buds may be shaken down, but the chrysalids within, not having reached beetle state, can be gathered up in the buds (if they are shaken down on cloths) and destroyed. Where this plan has been carried out in German experiment on low trees where the infested buds could be picked off by hand and destroyed, it has been found to answer excellently as a *prevention* of infestation for years. It is different in its action to the first-named plan, as in this it is the weevils themselves which it is hoped to get rid of, and thus lessen the amount of the *then* present pests.

Where trees stand in bare ground, stirring the surface in winter so as to turn the weevils out to the birds would do good; and something *might* be done, at the time of the appearance of the weevil, by "grease-banding," as used to prevent ascent of Winter Moths. At one time (that is, so long as it was thought that the female weevils used their wings but little) this treatment was thought desirable, but though recent observations have made this doubtful, still the plan might be worth experimenting with, and more especially to learn whether the female beetles ascended by *walking* in cold and sunless weather. Where a little time and trouble could be given to grease-banding the stems of half a dozen trees or so in an orchard when the weevils were beginning to appear, the information gained by examination of state of the bands might be of very general service.

OBSERVATION.—Many kinds of insect attacks besides those noticed above are also injurious to Apple in common with other orchard fruit trees. Amongst these, just as a few examples, may especially be named the Winter Moth (*Cheimatobia brumata*) and the Mottled Umber Moth (*Hybernia defoliaria*), and other allied kinds, distinguishable by their wingless females, and by the "looper" form of their caterpillars; and amongst beetle attacks, besides leaf feeders, the "Shot-borer" Beetles, the *Xyleborus dispar* and *X. saxoseni*, as doing much harm in the living wood.

But while on one hand it is desirable to class the attacks (so far as is possible) under the heading of the crops which they most affect, on the other, as very many of our orchard insects affect most kinds of our orchard trees, it is very difficult to make any regular division.

Therefore, to the best of my power, I have placed the notes of infestations either under the heading of the fruit crop to which they are especially injurious, or of that in connection with which the observations were sent to me; and also in the course of each account have given the names of other fruit crops to which the insect under consideration is recorded as being especially injurious.—E. A. O.

CHERRY.

Cherry Aphis.

Myzus cerasi, Fab.; *Aphis cerasi*, Fab., and many writers.



MYZUS CERASI.—1, winged viviparous female ; 2, wingless viviparous female ; 3, pupa : much magnified. After G. B. Buckton, F.R.S.

Infestation of "Cherry Aphis" is distinguishable by the black masses with which it not only clusters in thousands on the under side of Cherry leaves in gardens and orchards, but also in bad attacks extends to the tender shoots, buds, fruit stems, and even sometimes to the green fruit. It appears in early spring ; and in Cherry orchards is the cause of great mischief by the suction of these vast numbers of aphides drawing away the sap from the parts attacked, and thus causing the leaves to dry up and wither, and destroying the young shoots. Likewise from the excretion of fluid through their "cornicles," or "honey-tubes," everything in reach is covered by this gummy exudation, the pores of the leaves are choked, and the infested portions reduced to a filthy mass of black Plant-lice, excreted matter, and ruined leafage and shoots.

The infestation may be found from its first appearance in spring until the attack of the successive generations ends with the appearance of the egg-laying female in autumn, which is recorded as having been taken as late as the 31st of October.

The general blackness of the infestation is one very noticeable point. The winged female, producing living young (viviparous), has the body wholly black, the abdomen sometimes clouded with yellowish green, the honey-tubes also black, and the wings ample and broad (see figure, p. 49). The expanse of wings rather more than a quarter of an inch, the length of body not quite one-twelfth part of an inch.*

The wingless viviparous female, which is also about one line in length, is black and shining, the legs ochreous, with the thighs, feet, and tips to the shanks black.

The autumn egg-producing (oviparous) female is dark shining brown or ochreous brown; and the male, which also is to be found in October, is in great part brownish black, but with the small abdomen ochreous yellow, with five brown transverse bands, and four spots on each side.

The pupa is shining olive green, with resinous yellow-coloured wing-cases; and the larvæ are stated (in quite their earliest stages) to be dull white or pale yellow, the colour becoming darker with age.

This species is recorded by Kaltenbach as infesting the "sweet and the sour Cherry"; and by Dr. Cyrus Thomas† as found in abundance both on Cherry and Plum; and by Mr. Buckton as having been found in viviparous form on Black Currant about the end of October.

The means of prevention and remedy for this attack are the same which are mentioned in other kinds of aphid attack, for which see Index; but in this case, from the extraordinary amount of sticky dirt with which the leafage and shoots become loaded, it is particularly desirable to apply *washes* as soon as possible, and good *drenchings* even of water alone, sent with force so as to wash off much of the infestation and clean the leafage, are very beneficial.

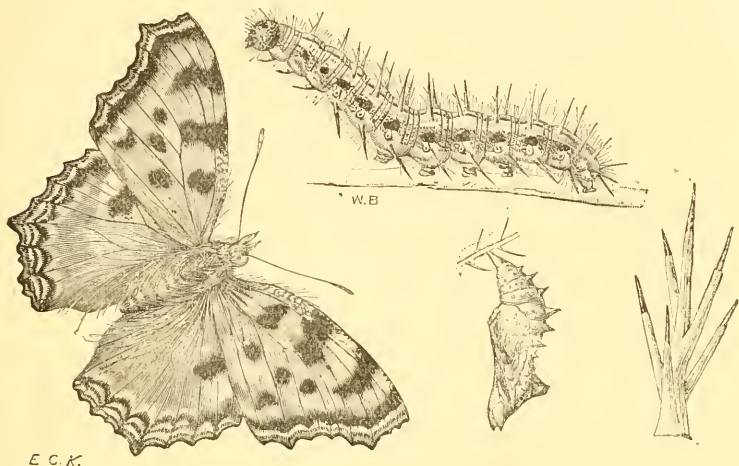
Large Tortoiseshell Butterfly. *Vanessa polychloros*, Linn.

The caterpillars of this fine butterfly, figured at p. 51, life size, in its three stages, are to be found feeding on Aspen,

* For precise measurements and detailed descriptions of *M. cerasi*, see Buckton's 'British Aphides,' vol. i. pp. 174-176.

† See "*Myzus cerasi*," in his 'Third Annual Report' as State Entomologist of Illinois, p. 75.

White Beam, Sallow, Osiers, and most especially on Elm; but the infestation also occurs on Cherry, Pear, Apple, and Quince. In France both the wild and the cultivated Cherry are recorded as being the trees chiefly selected for attack, sometimes to the serious extent of whole rows of trees being stripped of their leaves.



VANESSA POLYCHLOROS.—Large Tortoiseshell Butterfly; caterpillar and chrysalis, natural size; branched spine from caterpillar, magnified.

This species was recorded rather more than fifty years ago as being occasionally very abundant; in Stainton's 'Manual' it is mentioned that it "occurs in the south, but not generally common"; but the only fully observed report of mischief caused by its infestation sent me was in the summer of 1894 from Ossemsley Manor Farm, Lymington, Hants, by Mr. D. D. Gibb, the first observation of attack being sent me on the 19th of June. Though only occasionally injurious to a serious extent, the attack has such a power of destruction that it appears desirable to draw attention to it.

V. polychloros, or the Large Tortoiseshell Butterfly, is a remarkably handsome insect, about two and a half inches across in the spread of the fore wings, which are marked (as figured above) on the upper side with black blotches or spots on an orange red or tawny ground. Of these patches, two, which are large and squarish, and a smaller one, are placed along the fore edge of the fore wings, and four somewhat smaller patches are placed towards the centre and hinder part of the fore wings. The outer margin (along the tip of the fore wings) is dark, with an irregular pale line running along

it. The hind wings are tawny or orange red, with only one black blotch on each, and the dark border is varied with blue crescent-shaped markings, as well as by pale colouring forming a kind of irregular line outside them.

The under sides of the wings are marked transversely with wavy lines, the basal half being thus of a mottled and of a brownish tint, succeeded by a broad greyish band, and this by a dark border at the edge of the wing with a wavy blue band or line of blue crescents at the inner margin; in the centre of the hind wings is a little white spot. Along rather more than a third of the edge of the fore wings nearest the body (see figure, p. 51) is a row of long strong bristles, which are a marked structural characteristic, by which this Large Tortoiseshell Butterfly may be distinguished from the Small Tortoiseshell Butterfly, *Vanessa urticae*, often very common in our gardens, and which greatly resembles the larger species in colour and markings.

The life-history is that the eggs are laid in May, and in great numbers, on the twigs of the food trees of the caterpillars, sometimes completely surrounding the twig, so as to form a ring much like that of the Lackey Moth (see figure, p. 21); but, though placed close together, they are stated not to be "embedded" in glue. The caterpillars soon hatch, and live until their last moult in companies, spinning a web-covering for their common use. Their first food appears to consist of the buds and young leaves, and by day they go out to feed, and in the evening return to their web. Their headquarters are noticeable by the condition of the twigs, which are nearly or quite stripped of leaves, and also by the dirt which, falling down, accumulates in a patch beneath the tree.

The caterpillars are at first blackish grey, and strongly haired, and presently moult to an ochreous brown colour mixed with black, and beset with numerous branched spines of a yellow or ochre-brown colour, each spine tipped with black (see figure, p. 51). When full-fed they are about two inches in length, and they then disperse, and suspend themselves by the tail in any convenient place for their change to the chrysalis state, from which the butterfly may be expected to appear in two or three weeks. In this country the butterflies are recorded as developing from the chrysalids about the middle of July, and remaining on the wing for about a month, and then retiring for the winter, reappearing after hibernation (as before mentioned) to lay eggs in the spring.

The specimens sent me by Mr. Gibb corresponded well with the descriptions of the damage caused by this attack. Of two shoots of Cherry sent me on June 26th—these respectively of about five, and seven and a half inches in length—the leaves

were in most instances eaten down to the central rib. Of seventeen or more leaves on the longer twig there were only four with a fair supply of green remaining. Towards the end of the longest twig, amongst the stripped and curled mid-ribs, were many cast caterpillar-skins with some web, giving a good example of the habit of the caterpillars living in company in a common web until near full growth. The cast skins showed successive moults of the larvæ, and also showed the difference in colour with advance of age. The small cast skins were black or blackish, and most of these had the branched spines of a black tint; but in some instances the spine was tawny or of an ochre colour tipped with black, as in the adult larvæ. In all the specimens which I examined the heads were set with short, black, blunt points.

On the shorter twig was a patch of about an inch in length by a quarter of an inch in breadth of empty egg-shells. These egg-shells were mere whitish films, globular below and open above, with about six ribs running some way from the top down the sides of the miniature bowl. The eggs were fastened to the twig in about eleven longitudinal rows, the greatest number in one row being about thirty-three eggs.

Of the caterpillars sent me, some turned to chrysalis state on the journey, but in the case of one, of which I was able to watch the transformation, the tints were very beautiful. The figure (p. 51) shows the shape and the notched ridge running along the centre of the back; on each side of the back, excepting near the thorax, was a row of tubercles, yellow at the extremity and ringed with black. At the thoracic end of this row of tubercles they are replaced by three spots on each side, which at first are very conspicuous from their white mother-of-pearl-like lustre, contrasting with the reddish surrounding colouring. These six bright spots (three on each side of the chrysalis) gradually changed in tint, until on the 29th of June they were altering to a golden, and thence to a reddish tint. In the first colouring, the abdomen was mainly of an ochrey tint, grizzled with black above; the thorax much redder, as also the elevations above the wings. My specimens, probably from injury on the journey or in early stage, did not develop; but on the 28th of July Mr. Gibb forwarded me a perfectly developed sample of the *V. polychloros*, about two and a half inches in expanse of the wings, developed from his own chrysalids. Thus, including specimens of Large Tortoiseshell Butterfly which had been observed previously in the spring and seen by Mr. Gibb, we have a complete observation of the whole life-history of the infestation in one locality.

The attack was mentioned as having been very great in the neighbourhood on Elm and other trees.

PREVENTION AND REMEDIES.—This attack occurs so very seldom to any seriously hurtful extent that remedial or preventive measures are rarely called for.

In cases (like that of the 1894 infestation) where the large butterflies were observed in the spring, it certainly would be desirable, so far as the safety of the leafage of fruit trees and of some kinds of timber trees was concerned, to kill all that could be captured. Probably, as this species is rare as well as beautiful, a hint given to any neighbouring entomologist would secure very efficient help in this matter.

If patches of eggs are noticeable, these should be cut off, and a good watch kept for the webby or spun nest which makes a head-quarters for the caterpillars in their early stages. The gnawed leafage and the fallen dirt would be a guide to the whereabouts of these. On timber trees it would be hard to get at these nests, but on Cherry or other orchard trees something might be done by sending a boy up the tree to nip these off when the caterpillars were found to be within; or strong shaking and jarring of the branches to make them fall and then destroying the larvæ would do good.

Spraying with Paris-green would be an obviously useful method of treatment; and (where the great spiny caterpillars were in reach) hand-picking would be still more so, as thus, when they were full-grown and seeking places to suspend themselves from the tree for the change to chrysalis, something might be done to prevent recurrence of attack; but, generally speaking, the large and beautiful insects are so scarce that they might be left uninjured with little fear of consequences.

Cherry and Pear Sawfly. *Selandria atra*, Stephens and Westwood; *Eriocampa linacina*, Cameron.



SELANDRIA ATRA.—A, Slugworm and Sawfly, magnified, with lines showing natural length; B, cocoon.

The small blackish moist-looking larvæ of the Cherry and Pear Sawfly, known as slugworms, from their great resem-

blance to little slimy slugs feeding on the upper side of the infested leaves, are often not recognized as caterpillars from this very peculiar appearance from which they take their name. They feed on the leaves of Cherry and Pear, also on Plum, and sometimes on Peach, and on one occasion they have been forwarded to me as feeding on leaves of Quince; and they do serious mischief by devouring the skin of the upper side of the leaf, so that the remainder appears like a net-work of veins, held together by the skin of the lower side, which is left untouched, and turns to a deep brown colour.

The Sawflies (see figure, p. 54, with lines giving natural size) are shining black, with the horns rather longer than the thorax (fore body); legs black or fuscous, the front ones somewhat lighter at the lower parts; wings stated to be rather deep fuscous with the apex pale; nervures and costa (fore edge) black; stigma brown, and in the second submarginal areolet a small fuscous cloud. From differences of description of colouring of the legs it would appear that this is variable.

In the case of specimens sent me on the 19th of June, 1893, by Mr. Cresswell Ward, from Neasham Hill, near Darlington, I was able to watch the early stage of the attack, which is so rarely noticed that I give the observation in detail.

In this case the active stage of the attack to some of the leaves sent me was only just beginning, the upper surface of the leaf not being as yet stripped of the cuticle in patches, but dotted with little irregularly circular patches, some less than half a line in diameter.

The places of egg deposit were very observable. These were noticeable on the upper side of the leaf as little spots, roundish in shape, and whitish in colour (from the upper coat of skin being dead), slightly raised in the middle, and of a somewhat transparent tint just over the contained egg, which was a soft mass, compressible, thick, and somewhat circular in outline.

Most of the larvæ had hatched out, leaving only the white skin cracked where the maggot had effected its escape, but two eggs still remained unhatched. One of these eggs contained the white sawfly larva curled on itself within, and sufficiently developed to be of characteristic shape, that is, with the large segments behind the head, and the hinder portion of the maggot with the segments much narrower. In the other egg the contents were not yet sufficiently developed to be defined in shape. I did not see any larvæ in the act of coming out of the egg, but the smallest of them were as a general thing of a yellowish colour.

The little white blisters, or patches, of white dead skin

covering the eggs were about one-sixteenth of an inch across, and on one leaf, where I counted them, over thirty in number; on another there were about twenty-five; all these (with possibly one exception) showing on the upper surface of the leaf.*

Shortly after hatching, the grubs—which at first are white, afterwards yellowish—become covered with a blackish or dark greenish secretion, from which, and their lumpy shape (see figure, p. 54), they receive their name of slugworm. When carefully examined, they will be found to be much the thickest at the fore part of the body, and to have twenty-two pairs of feet,—that is, three pairs of claw-feet on the three segments next the head, none on the fourth segment, and all the rest of the segments furnished with a pair of sucker-feet. The pair on the the terminal segment are, however, so small that sometimes they have been overlooked, or not considered to exist, and the larva classed as twenty-footed.

When full-grown, which is in five or six weeks, the slugworms are about five-eighths or half an inch long, and they then cast their bottle-green smooth coats, and appear as buff caterpillars, dry and free from all slime or shininess, and, instead of being smooth, transversely wrinkled. After this the caterpillars go down into the ground, where they spin an oval dark-coloured or black silken cocoon, probably covered outside with earth, from which the sawflies come out some time in the summer of the following year. The earliest date at which I am aware of having received specimens of the attack is the 14th of June, and the attack may continue till October.

The destructive work of the caterpillars can be at times very rapid and complete. In a note of attack sent me from Worcestershire, a large Pear tree was noted as being stripped almost completely of its leafage in four days from the date of first observation, the leaves dying and drying from the skin of the upper side being eaten off. Somewhat earlier in the same year,—that is, on the 8th of July, 1896,—specimens were sent me of caterpillars said to be devastating the fruit trees in a garden in North Devon; “Cherry trees especially, a large one in a week was just a skeleton.”

The upper surface of the leaf is removed sometimes wholly, sometimes in patches; but the method of destruction, that is, the attack being to the upper side of the leaf, and the rest being left as the net-work of veins and thin lower skin beneath them, is characteristic of the attack.

With us, the damage is mostly observed as affecting Cherry

* See ‘Seventeenth Report on Injurious Insects,’ by E. A. Ormerod, p. 81.

and Pear; but it is mentioned by Mr. P. Cameron that "the damage done by these ugly brutes to fruit trees is very often immense; especially is this the case during very dry seasons. They are found on most species of *Pyrus*, *Prunus*, *Cerasus*, *Rubus*, and *Amygdalus*, as well as *Crataegus*, *Quercus*, and *Betula*."*

PREVENTION AND REMEDIES.—The slugworm attack can be checked by *dusting or syringing*. The caterpillars, if annoyed by throwing a caustic powder on them, such as quicklime or gas-lime, can throw it off at first by exuding a coating of slime, and thus, as it were, moulting off the obnoxious matter; but they cannot keep on continuing this process; therefore a second application of the powder (of course soon after the first) takes effect and kills them. If a good time is allowed to elapse between the dressings, they will have regained the power to produce the slime exudation, and the dressing will do little good.

Heavy *syrings* of the tree with strong soapsuds, applied by a powerful garden-engine, are very effective in getting rid of this pest. Tobacco-water will destroy them; and lime-water has also been found useful, in the proportion of a peck of lime to thirty gallons of water; it is noted that if two pounds of soft-soap are added, it will improve the mixture.

The sawflies have been found to fall to the ground on the *tree being shaken*, and to remain for a short time motionless; consequently it would be a good plan to place boards covered with wet tar, or cloths, beneath the trees, and shake the flies down on them early in the morning or late in the evening (or at whatever time it was found they were collected on the leafage), taking care that they were destroyed before they could escape.

The recurrence of the attack, which, when once established, is a very common circumstance, may be prevented by *skimming off the surface* of the ground and removing the cocoons. These may lie below the surface at from one to about four inches deep, according to the state of soil. If the earth is stirred over by a competent observer, little balls, probably much resembling the colour of the earth they are in, will be found, and may at once be identified by just tearing the spun case open, when the caterpillar or, later on, the chrysalis will be found within. When once the observer has found how deep these cocoons lie, it is easy to have the surface-soil removed to just below that depth, and by removing this and *destroying it, with the cocoons within it*, the infestation may

* See 'British Phytophagous Hymenoptera,' by P. Cameron, vol. i. p. 225.

be fairly carried out of the place; but care must be taken that the cocoons *are* destroyed, or otherwise the sawflies that hatch out of them will fly back to the trees and begin the attack over again. Where this plan is carefully carried out, there will be little damage to be expected from recurrence of attack.

But though many kinds of dressings and elaborate care in their application are recommended by various writers, I have found in my own personal experience that a good *dressing of lime and soot* well mixed up together and liberally applied answered every purpose, and a thorough washing down of the leafage on the following day, so as to clean off the adhering coating, was all that was needed to complete the work.

CURRANT.

Currant Aphis or Green Fly. *Aphis ribis*, Linn.

Currant Aphides, or “Green Fly,” are injurious by crowding beneath the under side of the leafage, and by their innumerable punctures and drawing away of the sap giving rise to the brightly-coloured blistered or lumpy growths so often seen on the upper side of the leaves of Currants. These blisters may be red, or brown, or orange in colour, and are convex on the upper side of the leaf, and concave below, thus forming hollows, in which the aphides shelter themselves in great numbers, and in bad attack the whole of the leaf may probably be distorted and crumpled out of shape.

The attack may be found from April onwards during the summer months, and affects both Red and Black Currants. Often it is of little importance, but where the “Green Fly” is very numerous, the leaves may be so much injured as to cause the fruit to be blighted.

By many writers the infestation is simply known as that of *Aphis ribis*, Linn., but consequently on a slight difference in some of the structural characteristics, the aphides are now (when minutely considered) separated accordingly as belonging to two distinct genera,—the genus *Rhopalosiphum* of Koch, and the genus *Myzus* of Passerini. The chief point of these differences appears to be that whilst in the case of *Rhopalosiphum* the tubercles on the forehead “are small or incon-

spicuous"; in the case of *Myzus* they are very observable in the male Aphis.*

The *wingless* viviparous females are in both species oval, shining yellow or green, with darker green mottlings; cornicles, or honey-tubes, paler green; legs also paler green, yellow, or greenish. *R. ribis* is a little larger than the other species, being a tenth of an inch in length.

The ground colour of the *winged viviparous female* is also, in both cases, yellow or greenish yellow, but there is some difference in the markings of the species. In *R. ribis* the head, fore body, horns, and feet are black; and the abdomen has some dark green patches on the back, and some spots on the sides; honey-tubes yellow, and legs ochreous. In *M. ribis* the head is pale olive; there are some olive and also some brown markings on the fore body, and several narrow irregular bands on the abdomen, with four or five spots on each edge; honey-tubes green or olive; legs green, with olive feet.

To ordinary observation these little "Green Flies" are so like one another that it is hard to distinguish them apart; but with a magnifying-glass the markings on the abdomen and the colour of the head are distinguishable. In the pupal condition *R. ribis* is green; *Myzus ribis* green or shining yellow, with two spots on the head.

The eggs are black, and laid on the shoots of the year.

The life-history of these aphides (which is similar to that of the others which belong to the division of the *Aphidineæ*) may be given generally as follows. The wingless females, which are produced very soon after the males in autumn, lay eggs; sometimes singly, sometimes in clusters. From these eggs, in the following spring (or possibly before), young aphides hatch, which are all females; they go quickly through their changes up to the perfect state, and then they produce living young, which also are all females. These successive generations of living young, *still all females*, some of which are winged, some wingless, go on until, in autumn, the last generation occurs, which is of males as well as females; and the females of this, as we said before, instead of producing living young produce eggs, which start the next year's attack.

The Apple and the Cherry Aphis, previously mentioned, and also the Plum Aphis (*Aphis pruni*), are similar in their life-history to the above, and where kerosine emulsion could be brought to bear on the eggs during winter it appears probable that it would act beneficially in preventing their

* For details, see 'British Aphides,' G. B. Buckton, F.R.S., vol. i. p. 180 (*Myzus ribis*); vol. ii. p. 9 (*Rhopalosiphum ribis*).

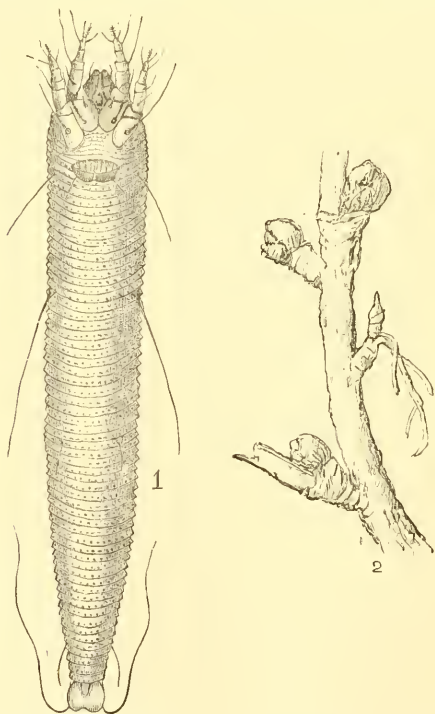
development, on which some remarks are given under the head of Plum Aphis; see also Index.

Where much damage is being caused to Currant leaves by the Green Fly, it is a good plan to break them off and burn them.

The infestation being beneath the leaves it is difficult to reach it by spraying; but in dry weather the application of *plentiful waterings* so as to keep up good growth of the leafage is in itself a great check to aphis increase. Where leaf growth is kept back by drought, aphides, as a rule, multiply much more quickly than where growth is luxuriant.

Currant Aphis is to be found also on Gooseberry leafage, and also sometimes on the common or wild Guelder Rose (*Viburnum opulus*).

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0.23 mm. (by permission, after Dr. A. Nalepa). Black Currant twig with Mite Galls.

The deformed bud growths, which for many years have been a source of great trouble to Black Currant growers, are caused by an exceedingly minute mite, too small to be seen by the naked eye,—scientifically *Phytoptus ribis*,—which propagates in the buds, and causes an unnaturally large development of these into spherical or somewhat oval soft green knobs formed outside of greenish scales or abortive leaves folding over each other, and inside of the various parts which would gradually have developed into leaves, flowers, and fruit, but contorted by the action of the mites into unnatural condition, and abortive for any useful purpose.

These “knobs” may be found forming during the winter whilst the healthy buds are still of their natural shape, and in January may be found up to as much as a quarter of an inch in diameter, and containing within them numbers of the mites and some eggs. Later on, growth of the gall knobs continues until they may at times be found as large as some specimens sent me from Toddington during the year 1897, which proved to be for the most part from about three to four-eighths of an inch in diameter, and, in the case of the upper specimens on the twig, were dying and drying off into the condition in which the mites leave them and emigrate to set up attack in the still embryo buds in the axils of the leaves.

The first definite allusion to the presence of this Black Currant bud disease being observed in England took place at the meeting of the Scientific Committee of the Royal Horticultural Society on March 2nd, 1869,* and the investigations carried on showed that as a very injurious attack (though of a nature of which the cause was not distinctly ascertained) the disease had been known in the district of Blantyre, N.B., for twenty years before the above date.

The first notes that were sent to myself regarding this infestation as a serious trouble were forwarded in March, 1885, and since then the attack has spread so widely both in England and Scotland, and the measures for its extirpation have proved of so very little more than mere temporary service, that the matter has become one of grave importance to all growers of Black Currants, especially where cultivation is on the scale of field growing.

Life-history.—*Phytoptus ribis*, or the Currant Bud Mite, belongs to one of the divisions of the order *Acarina*, or mites, but is distinguishable from all the other families by its more or less *elongate, cylindrical, or worm-like shape, and also by only possessing four legs throughout its whole life.*

* See reports in ‘Gardeners’ Chronicle’ for 1869, p. 252, also p. 276.

The mites of the other families of the *Acarina*—as, for instance, the Red Spider of the Hop, the *Tetranychus telarius*—are of a much rounder or more oval shape, but are especially distinguishable by their greater number of legs. As a rule, they possess three pairs when they are hatched and in their earliest stage, but, with subsequent moults, as they approach maturity, they become possessed of four pairs.

This point of the number of legs is a very important one to observe, in order to prevent confusion in identification with other kinds of mites which may very likely be found on Currant bushes.

Phytoptus ribis is of the shape figured at p. 60, that is, long, narrow, cylindrical, somewhat tapering towards the blunt tail, at the extremity of which, on each side, is one long bristle, and there are also two other pairs of bristles one on each side of the body—one pair near the fore part, the other a little before the middle. The proboscis is short; the four legs are plainly jointed, and the abdomen with about seventy punctate transverse rings. The length of the female is 0·23 millimeter, the breadth 0·04 millimeter; the dimensions of the male are smaller.*

The infestation is to be found on the Black Currant (*Ribes nigrum*) both in Great Britain and on the Continent of Europe. Likewise occasionally (but not as yet, so far as we are aware, in this country) on the Red Currant (*Ribes rubrum*) and the "Tasteless Mountain Currant" (*Ribes alpinum*). In regard to *R. alpinum*, as this kind grows wild in some localities both of England and Scotland, some investigation as to the *P. ribis* being found on it might be worth while.

From special observation of the habits of the Currant Bud Mite, and more particularly those of Mr. Robert Newstead, referred to below,† we find that mites are present in the swelled buds in the perfect condition in January, and not apparently injured beyond being made temporarily somewhat sluggish by severe frost. Eggs also are then present. In February eggs may be found in great numbers in the galled buds in company with the adult mites, and by March 6th "there were thousands of young forms (nymphs), and eggs and adults were also present."

* For practical purposes it is enough to mention that the mites are so excessively small as to be indistinguishable to the naked eye. A millimeter is the 25th part of an inch, and twenty-three hundredths of this measurement—that is, somewhat less than a quarter—is scarcely perceptible except when magnified.

† "Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5-7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

On April 19th (continuing to quote from Mr. Newstead) many of the old and badly infested galled buds of the previous year had opened out very considerably, but had not produced nor did they afterwards produce a single leaf. "These and the rest of the infested buds contained a living mass of the mites in all stages, completely covering every embryo leaf in the buds. . . . All the old buds that were examined had no living mites in them, but the dead white desiccated bodies of thousands of mites covered the surface of the dead leaves of the buds."

In May, galled buds which still retained any life in them (for 90 per cent. of the buds forwarded were dead and dry) contained "many dead mites, which had undoubtedly died a few hours previous to my receiving them, as they still contained their colour and outline intact."

Mr. Newstead's next observation is of great practical importance as showing the date at which migration takes place from the old galls to the embryo (the newly forming) leaf-buds, and consequently the date and the locality on the bushes, when and where (*if possible*) remedial dressings should be applied. "My next examination was on June 2nd. At this time the newly-formed shoots had begun to harden, and the new buds on the first half of them had attained a length of $2\frac{1}{2}$ –3 mm., very small, but just protruding behind the leaf-stalk. Between the base of the leaf-stalk and the buds, at the ends of the young shoots, I found both adults and nymphs, but no eggs; although these latter were not found in the situations indicated, they must have been laid there, or the nymphs would not have been present.

"It is curious to note that the mites occurred near the terminal buds only; this will account for such *buds* on an infested bush being most severely attacked. At this date (June 2nd) I could only find one of the old infested buds in a living condition, and this simply swarmed with adult mites.

"On July 17th I again found the mites located between the leaf-stalks and the buds, and with them many eggs; while ten days later (July 27th) newly-formed buds, still small, were present, but terminal ones were already showing signs of being infested. On examination these were found to contain adults, nymphs, and eggs, nearly all of which were located in the centre of the buds. This was the first occasion I found the mites within the newly-formed buds. The old infested buds at this date were everyone of them dried up.

"During the month of August I was unfortunately away from home, and was not able to resume my investigations until Sept. 13th. At this date the new buds showed decided signs of being infested; they were much swollen, and mea-

sured $2\frac{1}{2}$ to 3 lines in length, and contained the pest in all its stages. I could not, however, find any of the mites behind the leaf-stalks as previously, so that I concluded they had taken up their winter quarters for good, and had set to work in earnest to ruin the crop of fruit while yet in the bud."

From the above observations it will be seen that the mites first established themselves between the base of the leaf-stalk and the young buds early in June (June 2nd), but were not found actually inside them until July 27th.

In my own experiments of the present year (1898), on opening various Black Currant galls on January 25th and 28th, which I was favoured with, at my request, from the Woburn Fruit Farm, Ridgmont, Bedfordshire, I found a few eggs present.

These were oval or ovate when in characteristic condition, but sometimes irregular in outline, apparently from being pushed out of shape by the developing mite within; but I was not fortunate enough to find a specimen in the very act of developing (as I have seen in the case of the *Phytoptus* of the Birch knots), and thus did not have the opportunity of seeing (and figuring) the mite coming out of the egg in the four-legged condition in which it continues through life.

In the case of specimens from Woburn, I was particularly struck with the large size of the egg in comparison with the mite, and turning to the observations of Dr. A. Nalepa on this subject, I find that he notices that "the eggs" [of the Gall Mites] "are relatively to the minuteness of the creatures of considerable size. . . . The egg-shell is thin, flexible, and formed of chitin." The author also remarks:—"In the latter part of summer and in autumn the mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up."*

PREVENTION AND REMEDIES.—The method which is most frequently tried is breaking off the galled buds and destroying them, and though it cannot but be that in this way a great deal of the mite presence is got rid of which would have otherwise spread infestation, yet the plan is very far from answering as could be wished.

* 'Die Naturgeschichte der Gallmilben,' von Prof. Dr. Alfred Nalepa, pp. 15, 18. (Erganzter Sonderabdruck aus dem ix Jahrsberichte des K.K. Staats-Gymnasium in Wien, iv Bezirk). For technical description of *Phytoptus ribis*, Nalepa, species of *Ribes* (Currant) infested by it, and also figures, the reader is referred to 'Beiträge zur Kenntniss der Gattungen *Phytoptus*,' by the same author. (Besonders abgedruckt aus dem lxii Bande der Denkmäl Naturwissenschaftlichen Classe der K. Acad. der Wissenschaften, Wien, 1895).

In the following notes, sent me on April 7th, 1897, by Mr. C. D. Wise (Manager of the Toddington Fruit Grounds, Winchcombe, Gloucestershire), it will be seen we have details of the number of quarts of galled buds gathered in the years 1896 and 1897, with cost of gathering per acre; and also the *absence* of benefit from the outlay:—

“*Gall Mites on Black Currants.*—We have a very serious attack of Gall Mites this spring, as will be shown by the following statement:—

Field Number.		Quantity of Galled Buds picked per acre.	Cost of Picking.
1	1896	... 1½ quarts	3s. 6d. per acre.
	1897	... 12 „	7s. 6d. „
2	1896	... 2½ „	4s. 6d. „
	1897	... 8 „	6s. 9d. „
3	1896	... 4 „	5s. 6d. „
	1897	... 16 „	10s. 10d. „

“Where we have picked the Gall Mites off last autumn, the attack seems to be quite as bad this spring. You will see that the cost per acre picking off the galls comes to a very serious item, but I do not see that there is anything else we can do; if you can suggest anything we shall be very glad.”

On December 22nd (1897) Mr. Wise reported further:—“I am sorry to say that the Black Currant Gall Mite increases with us; the bushes this autumn are covered with galls.”

The plan of cutting off infested shoots to within two or three inches of ground level or even quite down to ground level, and in the former case treating the stumps and the ground round with an emulsion of soft-soap and paraffin oil, and in the latter liming the stools, has *not* answered, although where the emulsion was used the new shoots promised well for a time. In the other the young shoots were at once attacked.

Amongst observations of treatment from which some amount of good resulted was a note sent in 1885 of about half an acre being affected by the infestation, to which “a dressing was given of two parts sulphur and three parts lime boiled together in water (2 lb. sulphur and 3 lb. lime, 3 gallons of water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes.” The effect of this application was that little or no damage was done, but the remark was made that “it seems difficult to clear the garden altogether.”

Another correspondent mentioned on April 10th (1892):—“As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I pro-

cured from Messrs. Blundell, and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring, I had a boy gathering all the little knobs of the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop."

Some points, however, in the history of the mites which have been brought forward during 1897 suggest the time of year when (*if possible*) remedial sprayings should be applied. It is noted by Dr. A. Nalepa, see p. 64:—"In the latter part of summer and in autumn the mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up." This season, then, when the mites are straying on the bushes and as a preliminary to further mischief locating themselves between the leaf-stalk and the buds, as noticed by Mr. Newstead (see p. 63), is the time when the *mites are open to attack*, but there is the difficulty to meet of the fruit being on the bushes.

Also the last year's observations have confirmed the supposition that "mixed cropping"—that is, alternating lines (or strips of a few lines) of Black Currants with other crops—would lessen amount of mite presence. In reply to some observations of my own on this head, with which I was favoured in the course of last year by Mr. Malcolm Dunn, from the Gardens, Dalkeith, N.B., he remarked as follows:—"I have reason to believe that the usual method of *close rows*, in *large breaks* or quarters of Black Currants, has a good deal to do with the bad attack of mites so often seen on massed bushes; while single rows, with free space of some feet or yards between them are less infested in the same district. The close rows naturally afford better *shelter* and more *breeding ground* than detached rows, and hence the partial immunity of the latter. . . . There is little doubt the workers rubbing on the infested bushes with their clothes, when the mites are *lively*, carry them to clean bushes, and spread the infestation."—(M. D.)

The following note, sent me on Jan. 20th of the present year, by Mr. Lewis Castle, Manager of the Woburn Experimental Fruit Farm, from Ridgmont, Aspley Guise, Bedfordshire, gives some very serviceable observation on the above point:—

"Upon reflection, I think your suggestion with regard to planting Black Currants in lines between other crops is important, and likely to prove beneficial where the plantation

was gradually formed, and the bushes may be obtained from various sources. The fact that ours are all planted in such lines may have been partially the means of preventing the more general extension of the 'mite,' which is at present mainly confined to the one plot of Baldwins, though instances are observable in other plots, but scattered. Certainly it should be practised wherever it can be done conveniently, as bushes and trees of all kinds in single lines alternating with others ripen both wood and fruit better than when crowded into dense plantations."—(L. C.)

There are of course points difficult to be met on the scale of wholesale fruit-growing in the case of strip cultivation, but the cost would be less than the outlay for treatment (at present) almost unremunerative.

Other points occur as possibly serviceable, such as grafting Black Currant on species not liable to attack, and also experimenting as to whether varieties of Black Currant, which in special circumstances have been found not to be liable to the *Phytoptus* attack, will continue clean when in *Phytoptus*-infested surroundings.

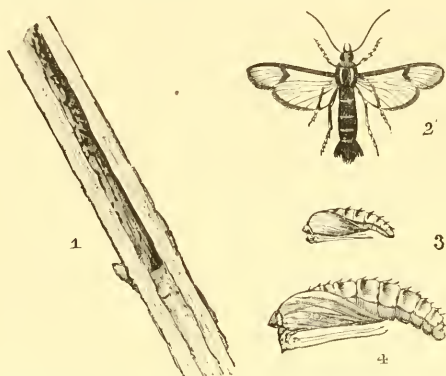
These and other points of carefully considered treatment are being now carried on, under the direction of Mr. Spencer Pickering, F.R.S. (Director), at the Woburn Experimental Fruit Farm, Ridgmont, Aspley Guise, Bedfordshire; and amongst them are included experimental sprayings with various chemical applications in carefully detailed proportions, the successive treatment being followed at specified intervals by microscopic examination by a skilled investigator of the contents of the sprayed buds, and of others unsprayed but otherwise in similar circumstances.

By kind permission of Mr. Pickering, I have been permitted to insert an account of the experiments now in progress in the Appendix to my Twenty-first Report, to which the reader is referred for the details from which this paper is abridged.

Currant Clearwing Moth. *Sesia tipuliformis*, Linn.

The attacks of the caterpillars of the Currant Clearwing Moth (often known as Currant-borers) have long been known as present, both in this country and on the Continent of Europe, and sometimes as doing much mischief by eating their way so as to form a tunnel of several inches in length up the centre of the shoots attacked. They are also amongst the species of injurious insects which have been carried to America, and which have established themselves there.

The infestation is to be found in the shoots of both Red and Black Currants (chiefly in the latter in the case of specimens sent to myself). It has also been recorded as found in Gooseberry shoots, and according to one observer it has likewise been found in the long shoots of Nut bushes.



SEsia TIPULIFORMIS.—Chrysalis, nat size and magnified; and section of portion of tunnelled shoot.

The most serviceable account of the habits of the Currant-borers which I am acquainted with is that given by Dr. W. Saunders in his excellent volume on American fruit attacks,* in which he gives the main points of the infestation as follows :—

“The female lays her eggs singly near the buds, where in a few days they hatch into small larvæ, which eat their way to the centre of the stem, where they burrow up and down, feeding on the pith all through the summer, enlarging the channel as they grow older, until at last they have formed a hollow several inches in length.† . . . Before changing to a chrysalis, a passage is eaten nearly through the stem, leaving merely the thin outer skin unbroken, thus preparing the way for the escape of the moth. Within this cavity the larva changes to a chrysalis. . . . Early in June the chrysalis wriggles itself forward, and, pushing against the thin skin covering its place of retreat, ruptures it, and then partly

* See ‘Insects Injurious to Fruits,’ pp. 336, 337, by W. Saunders, F.R.S.C., &c. Philadelphia, U.S.A.; and 16, Southampton Street, Strand, London, W.C.

† The only point of difference between the habits of the larvæ in the description above given and those recorded in Europe is continuance of feeding. Taschenberg, in his ‘Praktische Insektenkunde,’ notes the larva as feeding from “July or August until March of the following year.” This probably depends much on difference of weather and climate, and I could not have said with any certainty that, though some of my larvæ were partially webbed round, they had ceased feeding, as they were not all full grown.

thrusts itself out of the opening, when in a short time the moth bursts its prison-house and escapes, soon depositing eggs, from which larvæ are hatched which carry on the work of destruction.”—(W. S.).

The infestation has only been reported to me in one year (1894) as seriously injurious, and in that year from the distant localities of the South of Scotland, and of Kent; in both cases the attack was to Black Currants. In the first-named case a large number of specimens of caterpillars and injured shoots were sent me early in January, and on slitting these longitudinally I found the pith or centre eaten away for as much as five or over five and a quarter inches in length from where it had been cut across, this consequently only giving a portion of the length of the larval burrow. As in some cases the upper, and in some the lower part of the severed shoot was missing, I could not tell precisely how long the entire tunnel might have been, but it was very neatly and thoroughly cleared out, stopping abruptly at either end, as figured from life, p. 68. In this tunnel I found the larva lying, apparently hibernating, in several instances enveloped in a more or less perfectly spun covering. In one instance it was lying in a fairly firm opaque coating of dirty coloured web, with a deal of dark brown frass at one end where the grub was lying, and some at the other end. In another instance it was lying in what had been its roughly spun opaque covering, until it was torn open in slitting the shoot; and in another I found the grub lying with some rubbish or frass on one side, and a little web and frass at the other end.

The larva or grub was hardly half an inch long, pale or yellowish, sixteen-footed (that is, with three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair beneath the tail), the head palish chestnut, the jaws darker, and some chestnut marking on the segment next the head, and also above the tail. These larvæ were presumably not quite full-grown, as the full length is given by Buckler at three-quarters of an inch, and either from this, or from the conditions of hibernation, the colour of my specimens, examined in January, was rather lighter in the head and back of the following segment than the brownish tint mentioned both by Saunders and Buckton.

As some writers have expressed doubt as to the method of entrance of the caterpillar into the Currant shoot, I examined very carefully, and found no reason to doubt that the entrance was made at a bud, and that the maggot worked its tunnel above and below this point. The ends of the tunnel appeared (as a regular thing) to stop abruptly without any entrance hole, and without difference in width of tunnelling, which

might be expected to be the case if the larva entered when recently hatched and worked its way onward from one end. In regard to this point my correspondents wrote, "We have examined the shoots again, and the hole seems in every case to have been in the bud." My specimens developed by the chrysalis pushing through the aperture left for its egress, as on June 20th I found two pupa-cases fallen down, and another still attached to the Currant stem. Figures of one of these are given, life-size and magnified, at p. 68.

The little moth is scarcely more than an inch in the spread of the front wings; the body and fore body black with some narrow yellow lines; the wings are transparent, whence the name of "Clearwing," and bordered with black, the fore wings having also a black bar across, and the tip yellowish with black veins (see figure, p. 68). The moths appear in June.

In both cases it was stated that the infestation had not been noticed before, but, judging by the specimens sent me, the attack was to be found not only in shoots of the preceding year, but in those of older growth.

PREVENTION AND REMEDIES.—On the large scale of nursery growing the operation of taking cuttings would show fairly well where attack was present, and every case where one of the stems which had been cut through was found to have been tunnelled up the centre, the lower part of the shoot ought also to be cut away to below the bottom of the grub tunnel (so as to insure the removal of the grub), and *both pieces should be burnt*. The grub or caterpillar might be in either of the pieces, and if left, and merely thrown aside in the shoots might very likely go through its changes to moth state and set new infestation on foot.

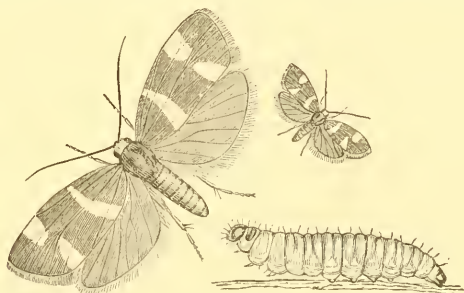
Where a ground has been clear until a lot bought as rooted cuttings from elsewhere has been found to be infested, it would be entirely desirable to clear them all off at once, and destroy them. In treatment of the old standing bushes, one of the surest plans appears to be to take the condition of the *leafage as a guide* to where the grub is present within the stem, and cut off every shoot as soon as fading leafage shows where the point of attack is.

As the chrysalis does not as a regular thing go through its changes till June, there would be plenty of time to give full attention to the matter, and cut off and *burn* all the shoots where the fading leafage showed presence of grub within, and thus give timely prevention of the spread of the infestation.

It has been advised to cut off all ends of old shoots which show a perforation, but in the light of later observations it does not seem likely that these stumps should be used for

egg-laying, as the larva would not be supplied with soft pith for food, nor would it be able to form its tunnel up and down in the customary manner. It has also been suggested (where the moths are numerous) that they may be captured and destroyed in the cool of the morning when sluggish; but for ordinary purposes the most practicable method of prevention appears to be (so far as is possible) destroying the tunnelled shoots, and where attack was very prevalent, it might be found that a manager, or *some one interested*, would be able, by glancing along the shoots, to distinguish by the condition of the bud, near which the entrance hole had been made (or possibly by the perforation itself being observable), which were the maggot-infested shoots.

Currant Shoot and Fruit Moth. *Incurvaria capitella*, Fab.



INCURVARIA CAPITELLA.—Moths, magnified and nat. size, from life; caterpillar, magnified, after Stainton.

Incurvaria capitella, figured above, has been known for a good many years as mischievous to Currants by means of its caterpillars feeding in the buds and also in the pith of young shoots of Red Currant; but it was not until the spring of 1896 (so far as I am aware) that we had knowledge of this infestation attacking the Black as well as the Red Currant. The specimens previously sent to myself had been from Red Currant (*Ribes rubrum*), and in the various entomological records to which I have access no mention is made of the Black Currant (*Ribes nigrum*) as attacked, the notes either referring to Currants without specification of kind, or distinctly to Red Currants.

In the year 1891 information was sent me by Mr. C. D. Wise (Superintendent of the Toddington Fruit Grounds, Winchcombe, Gloucestershire) of the mischief which had been

caused by this infestation (noticed about April 20th) in young shoots of Red Currant bushes, and specimens of the moth reared from these caterpillars (one of which is figured above) showed them to be *I. capitella*.

It was, not, however, until the careful observations of Dr. Chapman were carried on in 1892 that we learnt the remainder of the life-history of the little moth, and also that its attack is doubly hurtful to the Currants by *injuring the fruit* as well as the growth of the leaf-buds.

The main points of the attack from egg-laying in one summer to development of the moth in the next may be given shortly as follows:—The moth lays her eggs within the young fruit, and there the larvæ or caterpillars feed awhile, their presence being indicated by a premature appearance of ripening. After a time they creep out of the fruit, and each larva spins a cocoon in some shelter on the twigs, in which it passes the winter. In the following spring the caterpillar (as yet only partly grown) comes out, and, boring into the shoots of the Red Currant, destroys the shoot. It then goes into the chrysalis state, from which, in Dr. Chapman's observations, he found moths emerge in time to insert their eggs in the young fruit at dates of from the 17th to the 20th of May.

The first noticeable sign (in the spring of the year) of the presence of this attack, is the fading of the young shoots from the injuries caused by the gnawings of the little caterpillars within, which has been thus noted by various authors: "The larva is very injurious, eating the pith of the young shoots, and betrays its presence by the withering of the young leaves; when quite young it is dark red, but when full-fed it is greenish white."* Also: "The larvæ" (according to Stainton and A. Hartmann, of Munich) "live early in May in the young shoots and buds of the *Ribes rubrum*. These they devour even to the pith of the twig."

In observations sent me in 1891 from the Toddington Fruit Grounds (before referred to) by Mr. C. D. Wise, he mentioned that "about the 20th of April we noticed numbers of the young shoots of the Red Currant bushes had withered up and drooped. On examination we found in each a small grub which had bored its way up the stem." In April, 1896, Mr. Wise wrote further regarding injury to Black Currants, of which he forwarded specimens on the 27th:—"You will see what an enormous amount of damage they are doing us, as each bud contains a Currant blossom which is well formed, but which would not come to perfection."

I found the Black Currant shoots very much injured—in

* Stainton's 'Tineina,' p. 42.

some instances the boring of the little grubs went down to the old wood of the shoots, and in others I found the grub (or caterpillar) dead within; but two of these larvæ were still alive, one within a shoot, and the other straying about, and both, as customary with this grub for most of its lifetime, of a reddish colour.

When retiring for hybernation, the caterpillar is noted by Dr. Chapman as being two millimetres in length,* and that "it possesses well-developed legs, but the prolegs, though fairly in evidence, possess no hooks; it is red in colour . . . rather orange-yellow; head rufous, with sundry hairs; spinneret very long; second segment [that next the head, E.A.O.] has a plate arched behind, and narrowing to the front; along the hinder margins are darker stronger patches, in a central and two lateral portions, looking at first as if the plate consisted only of these in form of two lunules; anal plate triangular; several hairs on each segment." In the full-grown larva it is mentioned that the four abdominal pairs of prolegs possess hooks, but not the anal pair.

In the chrysalis it is noted that the wing-cases extend to the middle or end of the tenth segment, but are only attached as far as the sixth, and that in emergence it forces itself out of the cocoon.

The moths, which are observable in the latter days of May, are about five-eighths of an inch across in spread of the fore wings; head with a thick tuft of ochrey hair above. Fore wings dark brownish or fuscous, sometimes with a purplish satiny gloss, a pale yellow band across the wing at about one-third of its length from the root, and two patches, also pale yellow, about half-way between the yellow band and the tip of the wing; these two patches are respectively on the fore and hinder edges of the wing, and the hinder patch is somewhat triangular in shape. The hinder wings are pale grey.

The following extracts are taken from the clear account of the method of infestation of the young fruit given by Dr. T. A. Chapman from his own observations in his paper referred to below,† which I was kindly permitted by the writer and the editors of the Ent. Mo. Mag. to quote from in my 'Fifteenth Annual Report,' and now again quote with many thanks. Dr. Chapman commenced his record as follows:—

"Certain moths which I reared from the larvæ sent me

* One millimetre is the twenty-fifth part of an inch.

† See paper by Dr. Chapman entitled "*Lampronia capitella*," in 'Entomologist's Monthly Magazine' for December, 1892, pp. 297–300. In this paper, for various reasons there given, Dr. Chapman notes that he thinks it would be desirable to change the generic name of *Incurvaria* for that of *Lampronia*; but as I am not aware of the change having been made, I retain the name of *Incurvaria* as above.

paired readily in captivity, and, supplying these with a spray of Red Currant with berries rather more than half-grown, I had the pleasure of seeing the moth lay eggs in such Currants on several occasions. The moths were then sleeved out on growing Currants, and here also they laid eggs, though I did not see it done.

“The moth sits upon the Currant, and penetrates it in the lateral region; on one occasion the process occupied three or four minutes, on another only about thirty seconds. The dates were from 17th to 20th May. On examining one of these Currants, which was rather more than half-grown, and with seeds still very soft, but about 1·75 mm. in diameter, two eggs of *capitella* were found lying free in the ovarian cavity; in another the cavity contained two such pairs of eggs. . . . I have little doubt, however, that two eggs are laid at each penetration.” The eggs were nearly colourless, and somewhat lemon-shaped, about 0·67 millimetre in length, and 0·37 in breadth.

Continuing Dr. Chapman’s account in abstract: no change was noticeable in the Currants under observation until the last week in June, when most of the Currants being still green, some among them had the appearance of being nearly ripe, and these proved to be infested by *capitella*. In some the caterpillar was still present, in others it had escaped, and in two instances Dr. Chapman saw the caterpillar in the act of escaping by boring through the juicy substance of the Currant, and emerging a short way from the summit. “The food of the larva whilst in the Currant is the interior of one seed. . . . The buds and fruit spurs of the Currant have at their bases many dead scales that persist from earlier buds, and amongst these the young larva buries and hides itself, spinning a small firm white cocoon in which to pass the winter.”—(T. A. C.).

Thus the account is made complete throughout the year, up to the date when the caterpillars appear from the quarters in which they have passed the winter, and their renewed state of activity is made apparent by the fading of the young Currant shoots under attack (see p. 72).

It may perhaps be of some assistance to those not accustomed to observation of insect-life to draw attention to the circumstance of the *same* caterpillars *retiring twice* from active life in the course of the year, once when partially grown for their winter rest in their cocoons, and again in the late spring for their change to chrysalis.

PREVENTION AND REMEDIES.—One remedy is obviously to pick off and *destroy the infested shoots* which have been

bored by the little caterpillars which came out from the little white cocoons in which they passed the winter. Thus we get rid of a great quantity of infestation which would very shortly have supplied a new brood of moths to infest the Currant fruit with their eggs, and caterpillars hatched from them. As Mr. Wise remarked, relatively to the infestation at Toddington in 1891:—"The remedy we adopted for this pest was to pick off the infested shoots and burn them, which of course means a lot of labour; but what else were we to do?"

Dr. Chapman's observations of the young caterpillars which come out from the fruit, hiding themselves amongst the dead scales to be found at the bases of buds and fruit spurs, and there spinning a white firm cocoon in which to pass the winter, opens out another method of prevention. We could not very well do anything towards clearing out individually cocoons spun for the accommodation of a caterpillar only about one-twelfth of an inch long ("the young larva on retiring for hybernation is only 2 mm. in length."—T. A. C.); but looking over the bushes, and if little white spots were seen, clearing out the old rubbish in which the cocoons are sheltered, would be to some degree practicable. Or an application of strong soap and sulphur would do good.

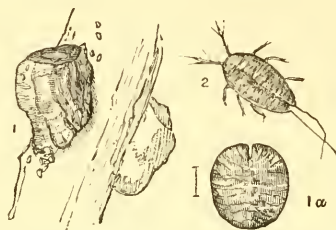
Whether anything could be done with regard to shaking off the infested and prematurely ripening Currants does not yet appear. In some other kinds of attacks in which, as in this instance, the infesting maggot destroys the seed, the fruit consequently drops, and if this should be the case also with our *Incurvaria* attack, we might get rid of much of the pest by shaking the bushes, so that the fruit should drop on to cloths, and destroying this before the maggots had time to escape and re-establish themselves on the Currant bushes to form winter quarters.

White Woolly Currant Scale. *Pulvinaria ribesiæ*, Signoret.

The presence of the infestation of the White Woolly Currant Scale is not easily overlooked, from the white woolly or cottony matter which forms the nest of the eggs, and of the young Scale insects in their earliest condition, gradually becoming drawn over the twigs in all directions (see figure, p. 77), so that in the distance the infested branches have the appearance of being scattered over with whitewash.

This species, the *Pulvinaria ribesiæ*, Signoret, is a kind of attack which has long been known in France, but which was

not scientifically identified and recorded as present in Britain until June, 1889, although we then found on investigation that it had been noticed as present at various places in England and Scotland during a few years preceding that date.



PULVINARIA RIBESIAE.—1, female and woolly egg-sac, magnified (natural size given at p. 77); 1a, female Scale magnified, with line giving natural length; 2, larva, magnified.

On June 18th specimens of the attack were sent me from a garden at Wakefield by Mr. S. L. Mosley, of Beaumont Park Museum, Huddersfield, with a note that “it evidently seemed at home where it was established, and that the Red Currant bushes were terribly affected by it”; and he drew my attention to the very great number of eggs in the cottony matter surrounding the Scale.

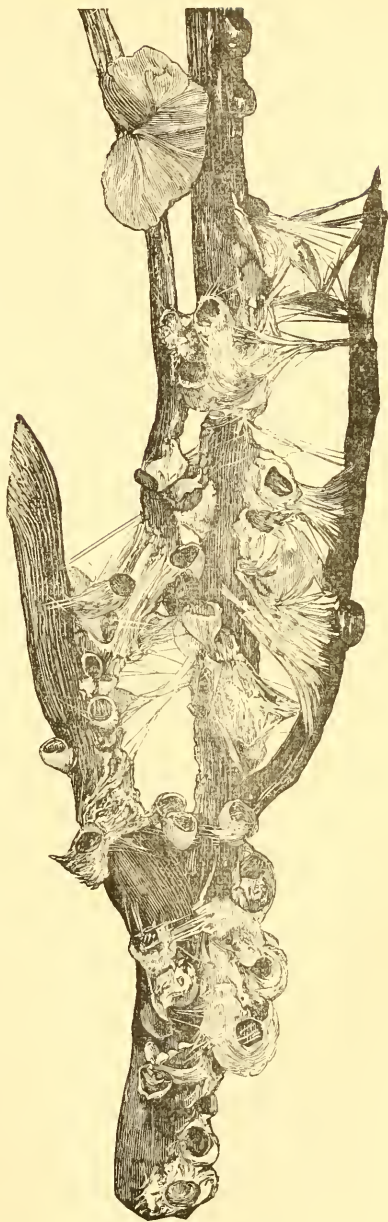
The specimens were submitted to Mr. J. W. Douglas, of 8, Beaufort Gardens, Lewisham, S.E., for authoritative identification, who reported on them as follows:—“The Coccids are *Pulvinaria ribesiae*, Signoret (*Essai sur les Cochenilles*, p. 219), a species found on Red Currant bushes in France, and which I have long expected to hear inhabited Britain, but until now I have not seen it.” As this species has not yet been brought forward here, I append in a note* a translation

* “In its most advanced stage this species, which is nearly allied to *P. vitis* and *P. oxyacantha*, is 4 mm. long by 3 broad, not including in this the white cottony matter, which may vary in extent according to the state of growth of the embryos which it contains. The Scale is of a reddish brown, with a line more or less raised on the back, which gives it almost the appearance of being keeled; on each side of the body it is wrinkled, and faintly pitted: in a dry state the folds are hardly observable—it might be said to be smooth. It is nearly allied to *vitis*, but smaller, thicker, rounder, more heart-shaped, and of a deeper brown; *ribesiae* is distinguished from it, especially in the embryo state, which is longer, with the members thicker, the tarsi and tibiae much shorter, and half less in size in *P. ribesiae* than in *P. vitis*, and the large hair which is observed on the tibia in almost all the species is very much longer in this one; the antennae, almost of similar form, have fewer long hairs; thus in the embryo of *Pulvinaria vitis* six are observable, whilst in *ribesiae* there are only five, of which that of the third article and that of the disc of the last article are much the longest, the great hair of the extremity of this article being a good third shorter than these. With regard to the cottony matter which is observable, it is very abundant in this species, and entirely of the same nature as that of *P. vitis*.”—*Essai sur les Cochenilles*, 15, *Pulvinaria ribesiae* nobis, par M. le Docteur Signoret, p. 219 (vol. i. of *Collected Essays*).

of Dr. Signoret's scientific description. My own more general description, from specimens examined on June 2nd, is as follows:—

The Scale itself (see fig. 1a, p. 76) dark grey-brown, rather longer than broad (the specimens measured from one-eighth to three-sixteenths of an inch in length, and over one-eighth of an inch in width), of a squarish oval, with the hinder extremity notched or heart-shaped, and in their then dried state the fore part turned up so much as to be reflexed; the keel along the back was still partly observable, with slight ridges running down to the edge of the Scale.

The white cottony or woolly matter (figured at 1, p. 76) which forms the nest of the eggs, and of the young Scales in their earliest condition, formed, where it was undisturbed, a compact tuft, on the front part of which the Scale itself was raised, sometimes almost vertically. Whilst fresh, the Scale and its white wool formed together a somewhat oval mass, which presently became drawn out in all directions, so that in the distance the infested branches looked as if they were scattered over with whitewash (see accompanying figure, from a photo kindly taken for me by Mr. T. P. Newman, of Haslemere).



Currant branch infested by White Woolly Scale.

The almost overwhelming nature of the infestation, and the serious amount of injury caused by it, is better conveyed by this figure, taken from one of the various samples of attack sent me, than from mere description.

The egg-like bodies in the wool, when examined at this date (July 2nd), proved to have hatched, and these orange-coloured larvæ were dispersing themselves in vast numbers in the box in which the spray of infested Currant sent me by Mr. Mosley was secured.

These very active young Scale insects (figure 2, p. 76) were whitish or orange in colour, of a flattened oval shape, broadest near the head, deeply cleft at the caudal extremity, with a long hair or filament on each side of the cleft, that is, one long filament placed on each lobe caused by the cleft, and in the centre of the cleft a long cylindrical process. The body somewhat raised along the centre, with slightly indicated corrugations along it, and side ridges from it, and the surface slightly sprinkled with white or woolly morsels. Eyes dark or black. One of the special characteristics by which this species is known is the number and length of the hairs on the antennæ, but in the size figured I have only been able to indicate that hairs are present.

The attack occurred on Red and White Currant (*Ribes rubrum*) and on Black Currant (*Ribes nigrum*), and also on the ornamental species (*Ribes sanguineum*); but with the exception of presence of the infestation at Wakefield and Huddersfield, and also at Ballater, which is not very far inland, all of the attacks were observed on or near the sea-coast on the East of Scotland, namely, in the neighbourhood of Banff, Aberdeen, Stonehaven, Arbroath, Edinburgh, and Berwick-on-Tweed.

In one instance noted by Mr. S. L. Mosley, F.E.S., at Huddersfield, he mentioned a row of forty good-sized Currant bushes against a wall, all of which were more or less infested. "The insects have not been noticed before, and were certainly not there when the bushes were shifted two years ago."

In the case of specimens of infestation sent me by Mr. Norman, of Cheviot House, Berwick-on-Tweed, he stated that the whole of the Currant trees in the garden from which they were forwarded, whether Red, White, or Black, were infested, and many of them thickly studded with the woolly nest of the Scale insect. The attack had first appeared five years previously, but was not known to have appeared in any other garden.

In the observations sent, the species was mentioned as a new infestation, or as one that had been observed two, or five, or six years previously, but not in any case as having been

noticed before the year 1880, and I have not had any further reports of observation since those of 1889.

PREVENTION AND REMEDY.—Under the circumstances, measures of prevention seem little called for; but it may be worth while to note that the plants, or parts of plants, most affected were bushes nailed to walls, or not fully exposed to light and air, or the under side of branches; consequently, all measures of *good cultivation* adapted to keep the branches or the bushes from being crowded up together or overshadowed would be useful, as also keeping a watch on Currant branches nailed to walls, where any infestation which especially affects the sheltered or under side of branches has every chance of establishing itself.

With regard to remedies, on July 21st, Mr. William M'Kenzie wrote me from the gardens under his charge at Glenmuick, Ballater, Aberdeenshire, that in 1880 the garden was visited by this Currant pest, and as he had never, after a long experience, seen it before, he first tried the common application of soft-soap as a remedy. This proved useless, as also did dilute paraffin oil, which, as Mr. W. M'Kenzie justly remarks, is an application not generally to be recommended, as it may do much harm if not judiciously used. These applications having failed, in the following year (1881) Mr. W. M'Kenzie "applied a *dilution of hot lime* in the autumn, going over the bushes with a brush (the same process as whitewashing), occasioning the bushes to shed or throw off the bark, and thus effectually curing them of the pest, without in the least injuring the bushes." The proportion used was "two pounds of lime to one gallon of water, being of the same consistency as is used for whitewashing walls." This application Mr. M'Kenzie found to be an effectual and permanent cure, and later on he forwarded me excellent specimens of both White and Red Currants, gathered off the previously-mentioned bushes, to show that the remedy had proved thoroughly effective against the infestation, and done no harm to the plants.

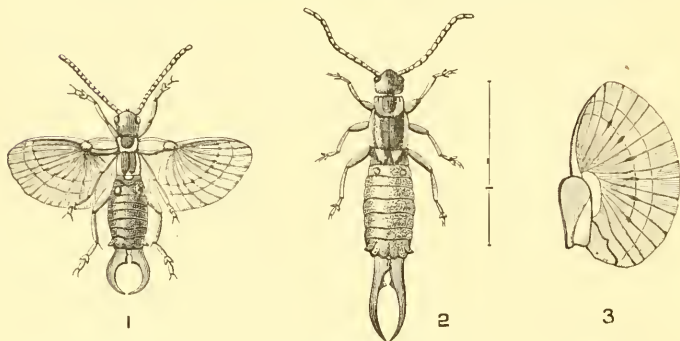
Where only a little of the infestation appears, it would be desirable at once to use the above or some other serviceable application, for if soft-soap alone did not answer, probably some of the common *soft-soap and sulphur* applications would not fail to kill the minute larvæ straying in crowds over the bushes, and kerosine emulsion has been found a very successful application for destroying the eggs of the allied species, *Pulvinaria innumerabilis*.* But where remedies could not be

* 'Insect Life,' vol. v. p. 103. United States Department of Agriculture, Washington.

brought to bear, it would be best to cut off and *burn* the infested branches, or to destroy and burn the infested bushes if it could be done without serious loss, and thus stamp out this newly-observed pest in good time.

EARWIGS.

Common Earwig. *Forficula auricularia*, Linn.



1, *FORFICULA AURICULARIA*; 2, *F. FORCIPATA* *; 3, wing of *F. auricularia*.
All magnified.

Earwigs cannot be placed under any one special horticultural heading as being injurious to any one kind of orchard or bush fruit crop in particular, and the amount of damage which they cause to fruit is less in proportion than that of their injuries to garden plants and flowers, as, for instance, to Carnations, Dahlias, &c.; or occasionally in years of great prevalence, as in 1886, to some field crops. Still they are visitations which occasionally appear in vast numbers, and which certainly include various of our orchard and more tender garden fruits in their depredations.

So far back as 1837 it was noted as follows in German observations by Kollar of the Common Earwig, the *F. auricularia*:—"In orchards it particularly injures the fruit of trees which are trained as espaliers, such as Peaches and Apricots,

* The figure of *F. forcipata* is copied from that by Prof. J. O. Westwood pl. xxviii., vol. vi. of Stephens's 'Illustrations of British Entomology'; but I understand that doubt has arisen whether it is a distinct species. Further on will be found descriptions of two variations in shape of the forceps of the male *F. auricularia*.

which are often entirely pierced through in warm weather. Earwigs also attack the other sorts of fruit, particularly Pears and Apples."

Kaltenbach (in his 'Pflanzenfeinde') notices of this same species that "they feed by preference on mellow and sweet fruit, which they often completely eat through, and do not despise soft leaves and petals of flowers, and destroy many caterpillars and pupæ."

Taschenberg ('Praktische Insektenkunde,' pt. iv.) mentions a little more in detail that "its food consists mainly of vegetable material, as, for instance, of ripe fruit, when it is sweet, and more especially what is lying on the ground, or at any rate is on boughs which are near a wall"; but Dr. Taschenberg does not consider that the Earwigs *climb* the trees; and in the year 1896, which (as well as 1886) was a year in which Earwig attack was unusually prevalent, I had a note from a correspondent near Gloucester, in which he mentioned:—"My Apple trees are *infested* with Earwigs. I do not know whether these insects consume any of the aphides; if they do, I should hesitate to destroy them. I am under the impression they eat the Apple flowers. I fear they do not interfere with any caterpillar life."—(A. B.)

It would help us very much in keeping Earwig visitation in check if we had some special observations as to how they arrive at the infested spots, with identification of the kind observed. We know that the "Lesser Earwig" (*Labia minor*, Leach), which is the smallest of all the European kinds, will fly in great swarms in sunshine, but, unless from their capability of clearing off young plants in frames, this small kind does not appear to be mischievous.* Also, in proof of some kinds of Earwigs flying at *night*, it was noted by Prof. Westwood "that in a small space of eighteen inches square, upon palings fresh coated with pitch on the previous day, no less than fifty or more of these insects had been captured, some of which had still their wings expanded."†

In a note published in 'The Field' on Sept. 25th, 1886, the year of the very worst prevalence of Earwig attack which has been recorded probably within memory, the correspondent remarked that (after various investigations mentioned, and killing as many as eleven hundred of the swarm on the walls by the light of a lantern) he then took the lantern to a Privet hedge of about seventy yards in length then in flower, and found "as many Earwigs as flowers." This, it will be remembered, was a year of most extraordinary amount of

* For some observations of habits of *L. minor*, see my 'Twenty-first Annual Report of Injurious Insects.'—(E. A. O.)

† 'Introduction to Classification of Insects,' vol. i. p. 403.

appearance, and Mr. Martin J. Sutton, writing to me on Sept. 27th, from Dyson's Wood, Kidmore, near Reading, remarked that he thought, "if possible, the plague at Dyson's Wood was even worse than that described by 'The Field' correspondent."

Looking at the above notes, it seems very unlikely that swarms of Earwigs should have arrived otherwise than on their wings, which are so eminently calculated to convey them; but rather that this species being nocturnal, its movements are not fully recorded.

The life-history of the Earwig may be shortly given as follows:—Early in the year the female Earwig lays (under stones, or in a hole in the ground, or amongst dry leaves, or the like places, but always in some concealed spot) a little collection of from fifteen to twenty yellowish eggs, by which she remains, or sits upon them, and collects them together again if scattered abroad.*

After the lapse of about a month the young Earwigs hatch; but still for a while the mother Earwig remains by her white wingless progeny, "like a hen by her chickens." The young, which soon become brown, are very like the full-grown insects in shape, excepting that for some time they have neither wings nor wing-cases; after several moults, the shape of the wings shows, and at the last moult, which is towards the end of August, the Earwig takes its perfect condition of male or female, with wings and all parts complete.

Earwigs are well known by their narrow long shape, with the tail ending in a pair of forceps (see figures, p. 80). *Forficula auricularia*, our commonest kind, is distinguishable in the males (see figure 1, p. 80) by the forceps being semi-circularly curved, and with the tips meeting, and a tooth within at the base†; in the female they are nearly straight. The colour is mostly of a dark red brown; the head reddish; eyes black; the shield-like portion behind the head very dark or black, with pale borders; behind this are the wing-cases (for position in repose, see figure 2, p. 80). These are placed flat, are very short, and meet at a straight line running along the middle, and are of a pale red or yellowish brown colour; a small triangular pale mark projecting from beneath each wing-case shows the tip of the "tightly-folded" wing beneath,

* For notes of personal observation of this singular habit, see 'Mémoires' of De Geer, vol. iii. p. 548; also of his own observation of it by Dr. E. L. Taschenberg in his 'Praktische Insektenkunde,' pt. iv. p. 188.

† In the 'Ortópteros de Espana y Portugal,' por Ignacio Bolivar, p. 29, is the observation that "this species presents some variations, of which the differences are chiefly based on the form of the pincers of the male, which may be long and little curved—var. *macrolabia*; or short, circumscribing a circular space—var. *cyclolabia*."

from which this order takes its name of Euplexoptera, or "tightly folded wings." At figures 1 and 3, p. 80,* the great size of the delicate membranous fan-shaped wing when expanded, as compared with that of its little scale-like cover, is given much magnified. The abdomen is mostly dark red or rusty black; legs very pale. The length is from about half an inch to upwards of three-quarters; and though by very far most numerous in summer and autumn, these Earwigs may be found during the whole of the year.

Their feeding-time is at night, and they shelter themselves from light by day. This may be under stones, or tiles, or bits of wood, or rough slabs or pieces of timber, or amongst withered leaves, or in badly pointed or ruinous walls. They are also to be found in great numbers in such shelter as is afforded them on their food-plants, as amongst the petals of Dahlias and Carnations, in the dried and curled leaves of Hops, or of Apple trees, or on wall fruit-trees, squeezed in between the nectarine or other fruit that they may have been ravaging and the wall, or, again, sheltering beneath fallen and half-decayed fruit on the ground. It is impossible to enumerate the variety of their hiding-places out of doors, from the broadscale shelter of a haystack to the chinks in a hop-pole; and indoors, in bad Earwig years, beds, boots, pastry, bread, anything which affords dark shelter, especially if it unites the convenience of food with it, may serve as a hiding-place.

PREVENTION AND REMEDIES.—So far as attacks to growing fruit are concerned it seems almost impossible to use any remedial measures, for jarring the branches when the fruit is in the ripe state, in which the Earwigs prefer it, would bring it down.

The only available measures seem—(1) taking care, so far as may be, that there are no available breeding-places or shelters; and (2) such broadscale trapping, as by lessening the aggregate number of the pests will lessen proportion of infestation to the fruit.

For the first, in gardens where Earwig attack is a regularly recurring yearly trouble, much might be done to lessen it, by disturbance of neglected surface-soils, keeping walls in such order as to afford no shelter, and even in orchards also something might be done by clearing the various kinds of rubbish, as wood, stones, clods of hard earth, &c., beneath which they hide. If the shelters are removed, the Earwigs will in ordinary cases be very much reduced in numbers, and as it is

* The expanded wing, figure 3, is from p. 151 of 'Our Household Insects,' by Edw. A. Butler. (Longmans, Green & Co.)

a common habit of Earwigs to lay their eggs under clods of earth, or in holes in the earth, or similar places, and to *take care of them*, all measures of cultivation which would stir the surface early in spring and disturb the Earwigs and their progeny would be of service. Taking care that walls should be in good order and well “pointed,” and also that house walls should be free from creeping or climbing plants, would lessen much shelter for the insects from which they come out to feed on wall fruit, or to enter our houses.

(2). In trapping, all the measures in use are simply varieties of plans based on the dislike of the Earwig to exposure to light, and its consequent habit of availing itself of dry and dark shelter after its nocturnal ravages. Simply for garden use probably the most convenient plan is the long known method of trapping by putting a little bunch of hay or straw in the bottom of a moderate-sized or rather small flower-pot, and then setting the pot wrong way up on the top of a stake to which the infested plant (as a Dahlia, for instance) is fastened. If the hay is well pressed into the bottom of the pot, its own elasticity keeps it from falling out whilst the pot is being turned wrong way up; and each morning the hay should be examined, or shaken out over a gravel walk, or broad board, or some hard smooth surface, so that the Earwigs which fall down, and would, if allowed, run away quickly, may be killed before they can escape. The pots can be examined and the Earwigs killed very rapidly, and a very useful clearance made.

On June 26th, 1896, I received, per favour of the editor of the ‘Agricultural Gazette,’ some communication regarding much injury that was being done to the Hops of a correspondent by Earwig attack to the leafage, and the following note (published in the ‘Agricultural Gazette’ for July 6th) shows good results from broadscale application of the above plan:—

“Yesterday I had about three hundred flower-pots, each with a wisp of straw in it, put on sticks, and this morning each flower-pot had from five to twenty-five Earwigs in it. I propose to put up about one thousand flower-pots, and hope in that way to lessen the attack.”

In a bad attack of Earwigs on an experimental plantation of Tobacco tried by the late Mr. Faunce de Laune, at Sharsted Court, near Sittingbourne, in 1886, the following note was sent me regarding the plans being tried to catch the Earwigs:—

“We have several plans of catching these insects. . . . The plan I have found to answer best is by hanging old bags on gates near the Tobacco, or on stakes amongst the plants;

old felt hats also catch a tremendous quantity by placing them on the top of stakes, and clearing them out daily.”—(A. R.)

Another plan of trapping, which is found to answer well for field service in Germany, is to leave old field weed baskets standing (presumably wrong way up) in one place for a day or two. When these are jarred smartly on the ground in the morning, even on a smooth clear piece of ground, it is stated that such numbers of Earwigs fall out, that it is difficult to trample on them all before some of them escape. In such a case, shaking them out on to a tarred board would be an effectual stop to their getting away.

Another German plan is to lay little bundles of Bean or Cabbage-stalks, or any kind of stems which Earwigs will frequent, about the infested field or garden bed, and clear these from time to time. In 1886, the year so especially remarkable for prevalence of Earwigs, one of my correspondents sent me the following note:—“Small heaps of straw laid at short intervals and fired on a still evening, after a few days, will destroy immense quantities of Earwigs and beetles.”—(R. W.)

The following observation by Prof. F. M. Webster, of the Agricultural Experiment Station, U.S.A., made during a tour in Tasmania, gives what might be a very useful suggestion as to methods of trapping Earwigs in this country also, especially when they are found infesting standard trees unconnected with others. Prof. Webster notes that there is in Tasmania a species of Earwig (*Forficula* sp.) which eats into and destroys ripe fruit, and remarks:—“It seems to me that these could be easily trapped, as I found them swarming in orchards and gardens, under boards and rubbish, and also on the bands on fruit trees used against the Codlin Moth, which were literally alive with them.”*

Prof. Webster does not mention the special kind of band, but the kind which is made of a strip of cloth or sacking doubled several times and tied round the tree by a string or wire run within the double at the top would appear to make just the dry warm shelter that Earwigs like. For full description, see previous paper on Codlin Moth, p. 13.

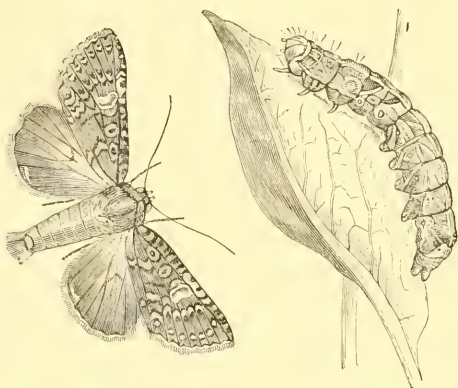
Other methods of treatment, such as shaking the Earwigs down at night on light trays well covered on the upper surface with wet tar, have been found to answer excellently where the nature of the crop attacked (as Hops, for instance) allowed it to be carried out; but for broadscale lessening of amount of infestation, such treatment, as that of which examples are

* See ‘Insect Life,’ vol. i. p. 361. United States Board of Agriculture, Washington.

given above, which provides the Earwigs with accessible warm, dark, and dry lodging, out of which they can be shaken in the morning, is, so far as we know at present, the most serviceable plan.

GOOSEBERRY.

Dot Moth. *Mamestra persicariæ*, Linn.



MAMESTRA PERSICARIÆ.—Dot Moth (from life); caterpillar, after figure by Dr. Taschenberg.

Mamestra persicariæ, or Dot Moth, is very common and widely distributed in England, as well as in various parts of the Continent; but although the caterpillar is a very general feeder, it has only been in one year (1890) that observations have been sent of it occurring as a fruit-crop pest. It does not, however, appear to have been generally observed as being prevalent in that year, for I do not find any reference to it in the 'Entomologist's Monthly Magazine'; and the only reference to the presence of this species in the 'Entomologist' is a short editorial reply to a correspondent, who inquired whether ivy on which he found the caterpillars feeding was not an unusual food-plant. The reply mentioned that the larvæ of *M. persicariæ* have been noticed this year feeding on Ivy, Poplar, Lilac, Plum, Clematis, and Raspberry; the bulk of them were some shade of brown.

Raspberry, as well as Gooseberry, is one of the recorded food-plants of the caterpillars of the Dot Moth, and the kind was noticed by Dr. E. L. Taschenberg as also in the year 1871 being found on orchard trees.

In the latter part of September, 1890, specimens of the caterpillar were sent me by correspondents near Leicester, with the observation:—"We have discovered an unusual visitor at this time of the year in Gooseberry and Currant bushes, as a very active and destructive caterpillar which divests the bushes of all their leaves."

The specimens sent gave good examples of the marked variety of colouring which sometimes occurs in the case of this kind of caterpillar. One was rosy brown with brown markings; another was rather smaller, and of a green ground colour.

On Sept. 30th I was favoured with the following notes of observation of attack by Mr. Oliver E. Janson, F.E.S., of Perth Road, London, N.:—"The larva of *M. persicariæ* has been exceedingly abundant and destructive to the leafage of various plants, including Gooseberry, in my own garden this year; there are still many left, although I have destroyed a great number. The variation of colour is very striking, especially the extremes you mention (rosy brown and a beautiful green)." A little later on Mr. Janson further mentioned:—"The gardens in this neighbourhood have suffered severely from the ravages of the caterpillar of the common 'Dot' Moth (*Mamestra persicariæ*), which made its appearance in extraordinary abundance about the middle of August, and lasted up to the end of September.

"In my own garden, although I destroyed some hundreds of them, their numbers seemed in no way diminished, and almost all plants were attacked by them; but Lettuce, Parsley, Mint, Gooseberry, Geranium, and Marigold they appeared particularly partial to and entirely devoured, and some, which were kept in confinement in a larva-cage, I found would feed as readily on Apple and Poplar as any other kind of plant. The colour of these caterpillars varies very much; the peculiar shading of the markings of various tints of green, grey, or brown render them very difficult to detect when at rest in the daytime on the stems or leaves of the plants."

The figure at p. 86 gives a good idea of the shape and markings and the size, when fully grown, of these caterpillars. The head is pale, and sometimes partly drawn back into the next segment, which has a dark patch on the back divided lengthways down the middle, and also bordered on each side by a white line, and a pale white line runs down the back. On each side of this line, beginning at the fourth segment

from the head and continuing to the eleventh inclusive, is an oblique darkish mark on each side of each segment; these slant backwards, so that the pair meeting at the centre of the back form a series of V-like markings, with the point of the V directed backwards. The foremost pair of these markings, as shown in the figure, are the darkest. Beneath these oblique marks is a wavy stripe running along the side, and beneath this again are five oblique bands (slanting in the opposite direction to the uppermost row), of which four run down the sucker-legs. The length, when full-grown, is an inch and a half or rather more. It is to be found in summer and autumn, and when full-fed, which may be towards the end of September, buries itself in the ground to go through its changes.

The sudden disappearance of such great numbers of large grubs, when their time for change to the chrysalis state has come, sometimes causes some astonishment. On Oct. 2nd my correspondent at Leicester wrote me that the large caterpillars on the Gooseberry bushes had "vanished as if by magic." But they simply leave their food-plants and bury themselves to turn to chrysalids in the earth, where they rest from October until May or late in June in the following year.

The moth is of the size figured at p. 86; the fore wings of a rich dark brown, or black ground varied with chestnut or rust-colour, and small pale spots or flecks at the tips and near the hinder edge, and they also bear a conspicuous bright white patch, or "dot" (of the shape figured near the centre), from which the moth takes its name. The hinder wings have the lower half pale, with a broad dark smoky band towards the margin, and the nervures are very observable. The eggs are laid up to twenty or thirty on the food-plants of the caterpillars.

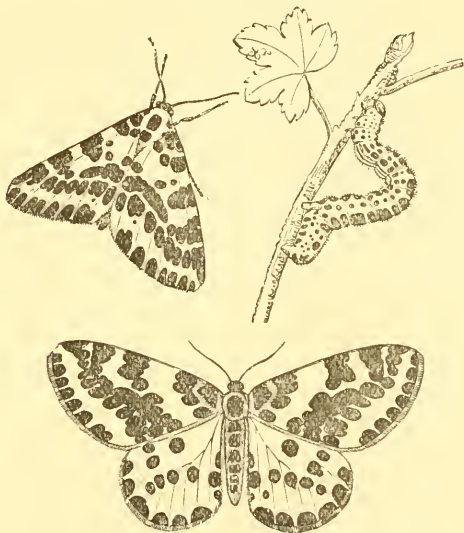
PREVENTION AND REMEDIES. — *Hand-picking* is a certain means of lessening amount, as these large caterpillars can be easily seen and removed; and recurrence of attack from the moths developed from chrysalids which have wintered in the ground may be prevented, or at least much lessened, by stirring the soil where there have been infested plants, so as to turn the pupæ up to the surface. Exposure to weather, especially to alternate frost and wet, when not in their natural shelters, may be expected to kill many of them; and also birds of various kinds would help much in their removal.

Syringings with soft-soap, kerosine emulsion, and other similar applications, to which references will be found in the Index, would almost certainly do good; and it is very possible that good drenchings of *thoroughly cold* water would do all

that is needed. If the caterpillars fell off with the shock, many could be killed by being trampled upon, and there would be a good chance that (with them as with some other moth caterpillars) the cold water, if applied in hot weather, would bring on such violent purging that they would very soon be reduced to mere skins.

Gooseberry and Currant Moth; Magpie Moth.

Abraxas grossulariata, Stephens.



ABRAXAS GROSSULARIATA.—Moth at rest, and with wings spread; caterpillar walking.

This pretty butterfly-like moth, known from the peculiarity of the markings on the wings as the Magpie, and also as the Harlequin Moth, is one of our most widely distributed garden leafage infestations, as it is to be found from the Orkney Islands at the north of Scotland to Kent and Devonshire in the south of England.

Amongst notes of Scottish localities, observations have been sent me from time to time of the caterpillars being found on Gooseberry and also on Red and White Currant leafage at Kirkwall Gardens, in Orkney; also at Dunrobin Castle, in Sutherlandshire, in the north of Scotland. On Black Currants at Portalloch, in Argyllshire. On Gooseberry and also on Black, Red, and White Currant leafage at Colinsburgh, Fife.

On Gooseberry and Currant also at Dalkeith Gardens, near Edinburgh, and at Oxenford Castle, in Midlothian.

In England it has been reported from Scotswood-on-Tyne, Northumberland, and from other localities in Cheshire, Herefordshire, Herts, Wilts, Hants, &c., showing the distribution of the insect over a large part of England.

The common garden food-plants of the caterpillars are, as mentioned above, Gooseberry, and Red and White and sometimes Black Currants, and the leafage of Apricot and Plum is also sometimes attacked. The leafage of the Blackthorn or "Sloe" (*Prunus spinosa*, L.) is also a favourite food.

The caterpillar is commonly of a creamy or yellowish colour, with a row of transverse squarish dark grey or blackish marks along the back; a row of little black spots along each side, and beneath these a row of larger black markings, beneath these an orange-red or reddish stripe, with again a stripe of black marks lower still along the sides of the caterpillar. Beneath the caterpillars there are also two narrow continuous black lines. Head and claw-feet black; the single pair of sucker-feet beneath the abdomen and the caudal pair of sucker-feet blackish outside.

Besides the orange or reddish stripe along each side, the segment next the head, and the under side of the third and fourth, and also of the four segments at the tail extremity, are of the same reddish colour. The colouring, however, sometimes varies in amount of black marking, even to being entirely black, without any mixture of yellow or other colour.*

These caterpillars are what are called "loopers," from the figure which they assume in walking (see p. 89). Besides the three pairs of claw-feet behind the head, and one pair of claw-feet at the end of the tail, they have only one other pair of claw-feet beneath the body (not four, as is the case with a large proportion of moth caterpillars). Consequently, as they have to bring this pair up to the claw-feet in order to steady themselves in progression, they form an upright "loop" in walking, and by this, as well as by their colouring, and by having only *one pair of sucker-feet beneath the body* besides the caudal pair, they are easily distinguishable from the caterpillars of the almost more destructive Gooseberry and Currant Sawfly, often occurring in company with them.

When full-fed the caterpillar spins a light transparent cocoon attached to twigs, or palings, or in crevices of walls; and in this it changes to a chrysalis, yellow at first, but

* See 'Larvæ of British Butterflies and Moths' (Ray Society), vol. vii. pt. i. p. 151.

afterwards shining black, with orange-coloured rings, from which the moth comes out about midsummer or rather later.

The perfect insect, which in its lightness of make and gay colouring more agrees with the general idea of a butterfly than a moth, is variable in colouring, but when regular in its marking is easily known. Commonly it has a black head, yellow body between the wings, with a large black spot in the middle; the abdomen also yellow, with five rows of black spots. The wings are white spotted with black, and the fore wings have a yellow blotch at the base and a yellow band across them. There are, however, almost endless varieties of markings, from black of different shades to white; some have the upper half of the wing white and the lower black, or the reverse; some have the ground colour of the wing (instead of merely a band) yellow; and in some cases the hinder wings are striped with black. It is noteworthy, however, that, as recorded by Mr. Robson, the black variety of larvæ observed by him near Newcastle-on-Tyne only produced the common form, not the especially black marked varieties of the moth. (See reference to black larvæ, p. 90).

The life-history of the insect is that the eggs are laid, one or more as the case may be, on the leaves of the attacked plants, "not only in the evening, but even in the middle of a warm summer's day."* These soon hatch, and the caterpillars may be found in August and September, and feed for a while, but, it is stated, rarely longer than for four weeks. Before winter they (in some cases) prepare a shelter by spinning the sides of leaves together, in which they may rest, and also spinning the leaf fast to the twig, so that when it fades the caterpillar still hangs securely in the hung-up leaf, but in others the caterpillars merely drop down and shelter themselves in the fallen leaves below the bushes. In these situations they pass the winter, but with the appearance of the leaves in the following spring they come out again, and feed on leafage until some time during May, or towards the beginning of June. Then they spin their light transparent cocoons attached to twigs, or palings, or in crevices of walls, or possibly on the ground, from which the moth comes out towards the middle of summer.

The duration of the whole life of the insect—that is, the time included in the egg condition in summer, subsequent caterpillar state in autumn, winter, and following spring, and chrysalis, from which the moth comes out towards midsummer—is about a year.

PREVENTION AND REMEDIES.—The habit of the caterpillar of

* Newman's 'British Moths,' p. 99.

wintering in spun-together leaves still hanging on the bushes, or sometimes lying amongst any shelter on the ground beneath, is the special habit to be acted on to get rid of it thoroughly. At pruning time the bushes should be very carefully gone over, and also examined afterwards to be sure that there are no leaves which may hold a caterpillar in the spun-together fold left on the bushes. Also, where the bushes have several stems so placed that infested leaves or insect vermin might lodge, it is particularly desirable that such lurking-places should be cleared out, or some trustworthy insecticide poured in. Where Currant bushes are trained on walls, search is especially requisite. It should also be borne in mind that the longer the pruning can be deferred, the more sure it is to be a good remedy. If the caterpillars have either not become thoroughly torpid, or the weather is sufficiently open for them to re-establish themselves, many will escape by creeping away and sheltering themselves again at the surface of the ground.

Pruning and dressing under the bushes should not take place until the time for the fall of the leaves is quite past.

This precaution applies also to date of dressing away possibly infested rubbish from beneath the bushes, which, as well as pruning, is a very desirable preventive. All the prunings and clearings from beneath the bushes should be collected and burnt, in order to avoid any chance of the caterpillars, which would otherwise survive in them till spring, coming out and crawling back to the bushes.

I have had notes from localities where caterpillar attack was *customarily* bad, and as far as I could judge it was the *non-complete removal of the infestation* consequently on the early autumn pruning and dressing of the ground beneath the bushes which was the reason. But if the bushes and the ground beneath are properly cleared, respectively by pruning and removal of hanging leaves, and by removal of *surface* shelter below, the pests are *so absolutely cleared out* that there is nothing left to continue attack in the spring.

Removal of the transparent cocoons from any places, as palings, walls, crevices, or boughs, towards the end of May or beginning of June, would of course be very desirable, for thus we should get rid of the coming brood of moths; but when the leafage on bushes and walls is in full early summer luxuriance, it is not likely the cocoons will be noticeable unless the infestation is to a quite unusual amount.

Amongst mechanical remedies, hand-picking, if the attack is taken in time, and a good number of workers put on so as to carry through the clearance at once where the Currant and Gooseberry growing is on a large scale, has been found to

answer well. Also (as a preventive), where this conspicuous moth is seen in large numbers, it would be worth while, and quite possible from its day flying and quiet habits, to lessen its numbers greatly by use of a common butterfly-net, or sometimes even with the hand.

Placing pieces of canvas or sheets below the bushes, and shaking or jarring the boughs sharply so as to dislodge the caterpillars, and then gathering them up in the cloths and destroying them, has been found good treatment.

For dustings or sprayings powdered hellebore is one kind of effective application so far as killing the caterpillars is concerned; but it is so very poisonous, and the effect would be so dangerous to all who partook of the fruit, unless it had been washed quite free from the dressing, that I cannot take upon myself to advise it.

Flour of sulphur dusted on the leaves *when the dew is on* so that the powder would adhere, or a liberal application of soot similarly used, are serviceable remedies and quite safe.

Paris-green sprayings, though these to succeed properly should be in such minute quantity of the arsenite contained that they would be (*demonstrably*) *perfectly without any cause of risk to the consumers of the fruit*, yet might raise a prejudice against it injurious to the seller. But the well-known "kerosine emulsion" would do much good without danger, and the "anti-pest" of Messrs. Morris, Little & Son, of Doncaster, which is almost the same as the "kerosine emulsion" of the United States of America in constituents, but is sold ready mixed in a semi-fluid state at a very cheap rate, would probably save much trouble and damage, from (respectively) the difficulty there usually is in mixing the "emulsion" so that the kerosine and soft-soap wash may unite permanently in the operation of mixing, and the great harm to the leafage in case the mineral oil separates, so that the kerosine (or paraffin) remains undiluted on one part of the leaves, and the soft-soap remains, not doing all the good that it was meant to do, on the other.

All the measures which are found serviceable in checking infestation of Gooseberry Sawfly (and of which notes are given under this heading) will be equally serviceable in lessening damage from caterpillars of the Magpie Moth, which are easily kept in check by moderate care.

Gooseberry and Ivy Red Spider. *Bryobia pratiosa*, C. L. Koch.
Also *Bryobia ribis*, n. sp., of Dr. Friedrich Thomas.



BRYOBIA PRÆTIOSA, from life; B. SPECIOSA (outline figure after Koch): both magnified. Leaf infested by "Red Spider," natural size.

During the spring and early summer of 1893 Gooseberry leafage was infested to a very unusual extent by a small *Acarus*, or "mite," commonly known as "Red Spider." This mite is of a different species to the well-known "Red Spider" of the Hop, and is very commonly to be found on Ivy leaves; but in this year, without apparently being less present on Ivy, it extended its infestation to Gooseberry leafage to an amount causing serious loss to growers in many localities.

This very unusual prevalence was almost certainly owing to the very unusual drought, which, as we all know, is favourable in various ways to increase of "Red Spiders," and demonstrably so from a great number of these mites not being washed off, or otherwise injured, by soaking moisture, or heavy driving rain-storms.

In the following year (1894) this "Red Spider" infestation reappeared as early as the 24th of February, but passed away much earlier than in the preceding year, no observations of its presence being sent me after April, whereas in 1893 presence of the pest was reported up to the 21st of June.

In 1895 the infestation again appeared in some considerable quantity, with some hot bright weather, but disappeared again (in the localities reported) with the occurrence of cold and wet, and (excepting where no means were taken to keep the attack in check) it was neither so widely spread nor so

serious as in the two preceding years, and has not since (as well as before) these three years been reported as of importance. But as an infestation which in favourable circumstances of drought and heat may suddenly develop into a cause of much loss to growers, it may well take a place amongst "bush-fruit" pests.

This *Acarus*, or "mite," propagates by laying eggs; when first hatched it has only six legs; when full-grown it has eight. The length cannot be distinguished without a magnifier, but at full growth this is about the thirty-second of an inch (that is, about a quarter of the eighth of an inch). The colour is variable, commonly of different shades of red from bright brick to duller tints, or sometimes of a bright brick or vermilion along the back, and darker at the sides.

This Ivy and Gooseberry "Red Spider" is distinguishable from the Hop "Red Spider" by the greater length of its two front legs (see figure, p. 94), and on submitting specimens to Mr. Albert D. Michael, F.L.S., that we might be perfectly certain as to the species, he was good enough to examine them, and to reply:—"They belong to the genus *Bryobia*, and are the *Bryobia prætiosa* of C. L. Koch, but I very much doubt this species being different from the *Bryobia speciosa* of the same author; you might really call them by either name; but this variety is Koch's '*prætiosa*.' The creature swarms in millions on Ivy in gardens at this time of the year." At the heading of this paper a magnified figure is given of *B. prætiosa* (taken from life), together with a copy of Koch's outline figure of *B. speciosa*. These give the general form, and especially the great length of the front pair of legs, which is a characteristic of the *Bryobia* (Koch).

The prevalence of the Gooseberry "Red Spider" was reported in 1893 from localities over a large area of country; from various places in Kent and Sussex, and from near Lymington, in Hants; in Hertfordshire it was present in my garden at St. Albans, and also at Watford. Special observations of the "mite" as a most destructive pest were sent from various places in Cambridgeshire, notably from near Wisbech, Histon, Meldreath, and Great Eversden, near Cambridge, and from grounds of growers up to as many as three hundred acres. More westerly, it was noticed as troublesome at Pershore, also at Evesham, in Worcestershire, and was observed as being present in great quantities near Cirencester by Prof. Allen Harker, of the Royal Agricultural College, and (passing on to the most northerly locality noted) it was present to a great amount up to the early days of June in the neighbourhood of Perth, N.B.

The following notes give a few observations of appearance

(with date of day of month) to show various points in the method of life of the "Red Spiders." On the 17th of March specimens were to be found moving quite actively on the leafage of the Gooseberry twigs sent me, which were about four or five inches long, with the leafage well forward, and a little of the blossom bud showing.

On the 19th of March, in a communication from a large Covent Garden firm, it was mentioned:—"We notice the Spider congregates in the crevices of the bark, and when the sun is out seems to get on the leaves; towards nightfall, again going back to the wood. Some pieces of the wood are literally painted with them. This is on a plot of about fifteen acres, which has been heavily manured every year."

About the same date in April, amongst specimens sent me from Pitfour Castle, Perth, N.B., I found the same kind of "Red Spiders" in great numbers; some bright red and active, and others congregated in the axils of the veins of the leaves close to the origin of the leaf from the leaf-stalk. This appeared to be a favourite position.

On the 23rd of May Mr. Francis Nixon (fruit-grower), of Great Eversden, near Cambridge, to whom I was indebted for much careful observation of the infestation, wrote me that he "had seen hundreds of acres looking ruined by this troublesome pest," and remarked:—"I have been into every fruit-growing district in Cambridgeshire, and everywhere it is the same. Not a single plantation have I found entirely free from it, whilst the ravages in most have been terrible."

On the 27th of April Prof. Harker, of the Royal Agricultural College, wrote me from Cirencester regarding the same infestation in a vast appearance on Ivy:—"To-day my boy and I found an amazing phenomenon on the leaves of the wall Ivy, on all the roads and gardens around here. Thousands, millions, of spinning mites! One leaf, not very big, had over one hundred specimens, and every leaf for almost acres had some. . . . I think I never saw such an army of living things."

Later on, Prof. Harker kindly sent me the following additional note relatively to observation of web spun on the infested leafage, which, whilst the attack was only just beginning, I had scarcely been able to find, even doubtfully, and usually not at all, on the sample leaves forwarded to me.

Prof. Harker wrote me:—"After some weeks the enormous numbers of mites gradually diminished; but they left behind them what had not at first been visible, their common webs, covering the whole of the Ivy for quite one or two hundred yards, from the ground to the top of the six-foot wall, and as these webs caught the dust and wind-borne *débris* of the

roadsides they became thick and matted, and quite disfigured the whole Ivy. Up to middle of August a few of the mites were still occasionally found.”—(A. H.)

Reports from different localities in the course of the various observations noted the attack as “very severe,” “destroying the bushes,” “committing havoc among the Gooseberry trees in the south of Sussex,” and otherwise showed the mischief caused by this minute leaf infestation.

Other Allied Species.—In connection with the appearance of the above-mentioned mite to an unusual extent on Gooseberry bushes in this country, it is of interest to note that another species, *Bryobia nobilis*, C. L. Koch, was observed by Dr. Fr. Thomas, of Ohrdruf, in Germany, as very prevalent on Gooseberry bushes (where it had not previously been observed as an infestation) in 1893 and 1894. Of this he remarks, after some preliminary observations on weather influences:—“I am of opinion that the increased amount of appearance of the small red mite of the Gooseberry bushes, which was observed in the course of the year 1893, and especially in the spring, was a result of the abnormal dryness of that year, a condition which was repeated in April and May of 1894.”

So far as I am aware, *our* infestation (so to call it) resembles in all points of its life-history and means of prevention of its ravages, the species, very fully described with all points considered, in the paper on the ‘Red Gooseberry Mite’ (‘Die rote Stachelbeer Milbe’) previously cited,* and here also the points of distinction between the above species of *Bryobia* and other very similar kinds, turning much on numbers of pairs of scales (Schuppen) on the back or elsewhere, will be found at pp. 493–495.

But for practical purposes for ordinary observers the following short report given by Dr. Fr. Thomas at Mülhausen, in Thuringia, later on in 1894, will be found to contain plain and useful information. In this Dr. Thomas spoke on the injury to Gooseberry bushes caused by *B. ribis*, n. sp., a small red-brown mite of about two-thirds of a millimètre in the length of the body, and demonstrated the extent of these injuries by specimens which he had taken just before the meeting from a garden in Mülhausen. These specimens had become whitish on the upper side from the suction of the mites, and the small remaining leaves had not power to provide a sufficiency of nourishment; the fruit dropped prematurely, and so did the leaves in autumn.

“The mites live from March and April until the beginning

* ‘Die rote Stachelbeer Milbe, *Bryobia nobilis*, C. L. Koch (?),’ von Prof. Dr. Fr. Thomas, in Ohrdruf (aus Wittmack’s ‘Gartenflora,’ 43 Jahrgang, 1894).

or middle of June, and in the early part of the spring may be successfully combated by plentiful sprinklings of the Gooseberry bushes with water, or occasionally with weak soap-wash.

"In May and June the mites lay small shining red eggs, which are plainly observable, with the help of a weak magnifying-glass, on the twigs, and especially on, and between, the remains of the old bud-scales. These eggs remain unchanged during the remainder of the year, and it is not until the following spring that the young mites escape from them. With regard to methods of prevention by killing the eggs, no information has been brought forward.

"Of the hitherto described species of *Bryobia*, the Gooseberry Mite, *B. nobilis* of C. L. Koch, comes the nearest; however, according to Koch's drawing and description, characteristic differences are present which clearly permit venturing identification of two species.

"As hitherto no notice has been given in German serials, or books of instruction, or in statements in known literature, of this increasing, and in dry years very dangerous, enemy of Gooseberry growing, the report in Wittmack's 'Gartenflora' of the year 1894, containing a fully detailed communication on the subject with figure accompanying, was published."—(F. T.)*

PREVENTION AND REMEDIES.—One important point is to *take the attack in time*,—firstly, that if even a single bush is infested it should be cleared so as not to make a centre of infestation for the following season; and secondly, when Red Spider is found to be in possession, remedies should be applied without delay. The necessity for immediate attention was strongly urged by various well-qualified observers.

For attacks of this nature there are no better applications known than *spraying* with soft-soap wash, or mixtures of soft-soap with mineral oil, or with sulphur. A home preparation of soap and sulphur mixture may be made in proportions of sulphuret of lime four ounces, soft-soap two ounces to each gallon of *hot* water. The soap and sulphuret well mixed before the hot water is poured gradually on, and the whole stirred into an even fluid, and applied at strength to be tested for safety after cooling. This, however, takes so much trouble that I have generally advised for a "soap and sulphur compound" that sold by the Chiswick Soap Company, Chiswick,

* 'Aus dem Sitzungsbericht der Frühjahrs Hauptversammlung 1894 (zu Mülhausen, in Thüringen). Sonderabdruck aus Mittheilungen des Thür. Bot. Vereins,' Neue Folge, Heft vi, 1894, Seite 10 u. 11. For both his detailed paper and this leaflet I am indebted to the kind courtesy of Dr. F. Thomas.—EDITOR.

Middlesex. This is procurable on application to the manager (I believe) at the same price as ordinary soft-soap, and I know it to act well as a remedy for various insect or mite attacks, and in a bad infestation of Red Spider on Lime trees it cleared it thoroughly.

“Kerosine emulsion” has been found in the United States to be a thoroughly effective remedy for a very similar kind of “Red Spider” infestation, especially “when a small quantity of flowers of sulphur has been added.”

For this preparation there are various formulæ, but one of the American Department of Agriculture recipes is as follows:—Add one gallon of water, in which a quarter of a pound of soft-soap (or other coarse soap if preferred) has been dissolved, boiling or hot, to two gallons of mineral oil; then churn the mixture by action of a syringe or pump for about ten minutes to the consistency of cream, and if this is properly done the ingredients will not separate after standing. For use as a wash or syringing the “emulsion” must be diluted with at least nine gallons of water to each gallon of emulsion.

Of this mixture Mr. J. Masters, of Evesham, the well-known fruit-grower, wrote me:—“We have found here that nothing has proved more effective than the ‘kerosine emulsion,’ as recommended in your ‘Manual.’ . . . We have found that it is best to apply the preparation to the bushes hot, say 80 to 100 degrees Fahrenheit. We boil the water, in which we put the emulsion in the proportion recommended; in this state we cart it away to our gardens in a barrel, and apply it to the bushes by the knapsack pump as soon as possible. The test is for the preparation to be as hot as the men can endure it to their backs. The results have been very satisfactory,—death to the Spiders without injury to the foliage. It should be done on a sunny day, as the Spider is then on the upper surface of the foliage, so that the spray comes immediately in contact with them.”

This point of the Spiders collecting on the leafage, and the desirableness of spraying whilst the sun is on, was noted by various contributors, and amongst other observations in a leaflet of directions for treatment written by Mr. Nixon, before mentioned. In this it is mentioned, at p. 3:—“Bushes should always be syringed when the leaves are dry, after 9 a.m., and preferably when the sun is shining, as then most Spiders are on the surface of leaves, where they can be the most easily got at, taking care to wet all the foliage. If it is likely to be a frost, the syringing should cease about 4 or 5 p.m. in order to allow the foliage to dry before the frost comes on.”

Should there be difficulty in thoroughly mixing the ingredients of the emulsion so that they remain *permanently*

incorporated, a preparation sold by Messrs. Morris, Little & Son, Doncaster, under the name of "anti-pest" will answer well and save much trouble, as, being sold ready mixed in semi-fluid state, it only requires diluting. The ingredients are similar in nature to those of the emulsion mentioned above.

Dry dressings, such as soot or slaked lime, have been reported to me as *useless*, as also the application of paraffin oil, much diluted, but without soap added.

From various observations sent it is shown that amount of "Red Spider" presence is increased by hot weather, and greatly lessened when, on the contrary, the weather is cold and wet. On April 8th I was favoured by one of the fruit salesmen of Covent Garden Market with the following communication:—"I found about a fortnight ago, when we had two or three hot days, that my Gooseberry bushes seemed almost covered with Red Spider, and at once provided myself with the wash. But the bud then was so tender that I hesitated to use it, and since the wet colder weather of the last fortnight the pest seems to have disappeared. I hear greatly the same report from Kent. Is it possible that the Spiders, developing before the leaf, have been killed by cold and wet? I hope so."

This characteristic can be utilized practically, for in Dr. Friedrich Thomas's publication, referred to in note, p. 98, he mentions that the continued application of moisture partially stupifies the "mites"; that it causes a lethargic condition, from which they recover on being dried by surrounding circumstances, but in which if continued for some days they waste. From this it would appear that if the infested surface of the ground was turned down and thoroughly well wetted (especially if some soft-soap mixture was added, which would still further choke their breathing apparatus) that it would do much towards destroying whatever Red Spider might be on or in the earth.

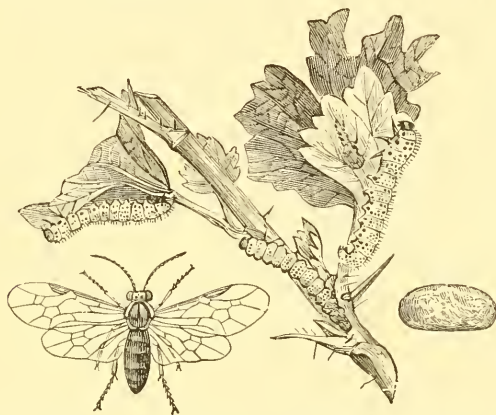
From practical observations it is obvious that well *washing* down the bushes with whatever mixture may be preferred *as soon as ever the first* beginnings of "Red Spider" presence are noticeable is very important.

Other means of lessening the amount of the Gooseberry Red Spider lie in cleaning and scraping rough bark (especially during winter), so as to remove shelters for these mites or their eggs, also in pruning off as much rough wood as could be spared; and running soft-soap into angles between the branches would also be of use.

The fact of the eggs being found in the crannies of rough bark during winter, and of the mites similarly sheltering during the

season of their fully-developed presence, points directly to the advantage of scraping off and getting rid of rough bark as far as can be managed, and also of removing gnarled and rough-barked boughs; also, and very particularly, of syringing and running soft-soap washes down the stems so as to fill the crannies and angles of the branches, and thus choke up the lurking-places, and stifle the mites within them.

Gooseberry and Currant Sawfly. *Nematus ribesii*, Cameron.*



Male sawfly, caterpillars, and cocoon; all magnified. After figures in Reports of the Entomological Society of Ontario. Dimensions given below.

The attack of the Gooseberry and Currant Sawfly is perhaps one of the most destructive that bush-fruit growers have to contend with, on account of the frequent recurrence of the infestation, its prevalence in the island from its most northern to its most southern counties, and its great powers of ruining the leafage of the attacked bushes, even by scores of acres.

When very young the sawfly caterpillars are green, with black heads, and with minute black points on their bodies. When full-grown they are about an inch in length; the ground colour green or pale-green; the segment next to the head and a little of the next one orange-coloured; so also are the tail segments, but with such a large black mark above,

* This species is the one fully treated of in notices in the Reports of the Entomological Society of Canada under the synonym of *Nematus ventricosus*, Klug, and I have added the name of "Cameron," as above, to the name of *Nematus ribesii*, as it is the specific designation chosen by him in his ' Monograph of British Phytophagous Hymenoptera ' ; and at heading of his paper on this insect—vol. ii. p. 168—will be found a list of its various appellations.

with smaller dots at the side, that the tail is sometimes described as black. They are furnished with a pair of black claw-feet on each of the three segments next the head; the next segment is legless; and on the succeeding six segments is a pair of pale-coloured sucker-feet, and there is another pair beneath the tail, making twenty pairs in all. The caterpillar is sprinkled with dots or patches of black, until its last moult, when these are thrown off with the skin, and the caterpillar becomes of a pale-green, but still orange behind the head and on the tail; the head also is paler. This change of colour with the last moult is particularly to be noticed, as otherwise it may be supposed that two species of caterpillars are present on the leafage. The number of feet should also be particularly noticed.

After their last moult the caterpillars go down into the ground, where they form a yellow-brown cocoon of a gummy secretion, in which they turn to a green or yellowish green pupa, orange on the thorax and apex of the abdomen. From this the sawfly comes out in about three weeks during summer; in the case of the late broods the grub remains unchanged in the cocoon during winter, and does not turn to the chrysalis till spring, in time for the Gooseberry Sawfly to make its appearance as the Gooseberry and Currant bushes are coming into leaf.

The general colour of the sawflies is yellowish; the mouth pale testaceous; the thorax with some large black marks in the female, in the male all black excepting one yellowish mark; abdomen yellow or orange, but in the male the back of abdomen black excepting at tip. Legs pale testaceous, parts above the femur or thigh white; black tips to the posterior shanks and feet (these sometimes wholly black); anterior feet also tipped with brownish or black. The four wings transparent and iridescent; stigma (mark on the fore edge of the fore wings) black. The length is from a quarter to a third of an inch, and the expanse of the wings is about half an inch in the male; rather more in the female.

The life-history is that the female sawfly appears about May (or earlier), and lays her eggs beneath the Gooseberry or Currant leaves, inserting them in the skin of the leaf very slightly by the side of the largest veins. The grubs soon hatch, and begin feeding on the leaf on which they are placed, which they soon pierce full of holes, and continue to feed on until it is partially or wholly devoured, excepting the mid-ribs. Thus they continue their work of destruction, moulting from time to time until they are three-quarters of an inch long, and may be seen scattered round the edge of a partially devoured leaf, holding on by their fore-legs with their tails in

the air. After the operation of casting the skin for the last time they rest awhile, and then go down into the ground and bury themselves, to turn to the pupal state, from which, as mentioned above, the sawflies come out in three weeks in summer, or, in the case of the late broods, in the following spring or early summer.

The following observation (taken from many), which was sent me on the 15th of May, 1895, from Shalford, near Guildford, gives a notable example of the great and rapid destruction of leafage which can be caused by this infestation:—"I have sixty acres of Gooseberries attacked by the sawfly caterpillars. . . . The ravages committed within the past three days are perfectly astounding, despite the fact that every available hand has been put on spraying with quassia and soft-soap, whilst others follow and spread slacked quick-lime on the creatures as they lie under the trees. We are picking the fruit as fast as possible where we have not used the spray, but with such a big ground there appears little hope of stopping the mischief."—(E. E.)

PREVENTION AND REMEDIES.—*Autumn or winter removal of surface-soil from under the bushes.*

For prevention of all attack, excepting what may be borne on the wing by stray sawflies blown from elsewhere, I believe the above plan to be the most certain.

The caterpillars go down in autumn a little below the surface, the depth varying from about two inches to somewhat more, according to nature of ground. There they lie in small brown cocoons, like little pellets of earth, during the winter; and when the leafage comes out in the spring, so do the sawflies from their cocoons under the bushes, and lay their eggs to start attack on the leaves. If the earth is removed, with the cocoons in it, and got rid of in any way, the amount of attack is enormously lessened.

Amongst communications sent me during several years (whilst this sawfly infestation was under special observation) by superintendent horticulturists and others regarding remedial measures which were found practically serviceable, the following are so plainly stated, and so trustworthy, that I repeat them again as they stand in the second edition of my 'Manual,' with the names of the contributors appended.

"For twenty years Gooseberry Sawfly caterpillars have not occurred in the gardens under treatment in any quantity. The surface-soil under the bushes is annually removed in winter, a deep hole is dug in one of the quarters, and in this the removed soil, *with whatever may be in it*, is buried. The soil under the Gooseberry bushes is replaced by that out of

the hole, with the addition of some manure.”—(Alex. Anderson, The Gardens, Oxenford Castle, Dalkeith, N.B.)

“When there is reason to fear an attack” [*i. e.* when there has been bad attack the previous year (Ed.)] “the soil should be removed to the depth of two inches round the bushes in the early spring, and a good sprinkling of lime dusted round each bush; by this means the caterpillars are cleared away and destroyed.”—(George McKinlay, The Gardens, Kilconquhar House, Fifeshire.)

“Caterpillars not nearly so injurious as last season. During the winter I removed all the surface-soil from under the bushes.”—(John Matheson, Addington, Winslow, Bucks.)

“Gooseberry bushes in my garden, from beneath which the earth had been scraped a few inches deep in the previous autumn and replaced by manure, &c., were free from attack.”—(E. A. O.)

I also received a note from a gardener in the district near Isleworth where Gooseberries are largely grown, that one method of treatment is to scrape all the surface from beneath them in the autumn and to form it into a line between the rows of Gooseberry bushes, and there *dig it in*.

In this way a great amount of attack is prevented, but it is necessary to be careful as to having the scraped-off surface-soil *dug in very thoroughly*. On one occasion I saw the first part of the operation carried out on a large scale,—the earth was scraped from under the bushes and formed into lines between them,—but there work stopped; consequently the cocoons lay just as safely as if nothing had been done, and when spring came the Gooseberry leaves were again riddled by the caterpillars. The plan advised above by Mr. Alex. Anderson, of digging a deep hole and burying the infested earth safely away, is much more secure.

This complete removal of the soil with the cocoons is quite worth while wherever Gooseberry caterpillar is prevalent; but, in case of the surface-soil not being removed, a layer of unslacked lime, well mixed with the soil as deep as the cocoons are, would be highly beneficial. Gas-lime also would be of service, well *sprinkled* on the surface, if fresh, or lightly pricked into the surface-soil beneath the bushes after it had been aired for a few weeks, taking care not to let it lie against the stem.*

The following notes refer especially to use of *lime or gas-lime* as above mentioned. Mr. George Brown, writing from Watten Mains, Caithness, N.B., mentioned:—“Year after year these attacks occur, and nothing in the shape of prevention is ever attempted; dressing with quick-lime, and

* For references to method of use of gas-lime, see Index.

clearing away the earth beneath the bushes, seems to be the best and surest measure."

Mr. Arthur Ward, writing from The Gardens, Stoke Edith Park, Hereford, noted:—"Currants and Gooseberries out in the open garden have kept quite free from caterpillars (on the *open ground*); this, I think, was owing to the trees being dressed with lime early in spring. We have had very fine crops, and the flavour is excellent. Currant trees on the *wall*, which were not dressed with lime, were attacked. The attack commenced on the bottom of the tree on the leaves nearest the ground."

At Callendar Park Gardens, Falkirk, Mr. T. Boyd mentioned:—"I dress over all my Gooseberry ground with gas-lime in early spring before forking over the soil, and have not seen one of these caterpillars for three years." And Mr. Thomas H. Hart, of Park Farm, Kingsworth, Kent, also reported:—"I am now satisfied that I have benefited by the application of gas-lime between my bushes. Grubs there certainly have been, but, whilst they have almost stripped other bushes of their leaves, those on the dressed ground are little the worse for the attack."

When the caterpillars are observable on the bushes, hand-picking, or shaking down and destroying, syringing, or dusting with various dry dressings, sulphur more especially, have all been found to answer.

Hand-picking has been especially recommended, or the less tedious, though less complete, way of shaking the caterpillars down; or syringing, and then shaking and destroying the grubs by trampling, or throwing hot lime on them. The plan of having freshly tarred boards placed below the bushes to retain them as they fall, or beating down on to cloths and collecting the vermin and destroying them, also answers well.

For syringing, the following mixture has been recommended:—Three gallons of warm soap-suds, half a pound of soda, half a pound of salt, and a handful of soot; the bushes to be syringed on a still day when the sun is off them. Half an hour after the application the plants should have clean water dashed over them. It is stated that this mixture does not injure either the young fruit or leaves, and soap-suds by themselves syringed on the bushes have been found useful. In short, anything that annoys the caterpillar, and makes the leafage distasteful to it *without injuring the leaves*, will be of service; but at the same time the fluid applications are hardly practicable on the large scale of fruit farming.

Dry dressings are more easily applied on a broad scale, and amongst these flour of sulphur has been especially recom-

mended, dusted on the leaves when the dew is on, or if in dry weather after watering.

Mr. W. J. Goodwin, of Winfield House, Crouch, Sevenoaks, reported that he considered "the best remedy for Gooseberry caterpillars is to give a liberal sprinkling of fresh, good soot early in the morning when the trees are damp, two or three large handfuls to a good-sized tree, so as to make it *quite black with soot*. It is of no use unless it is done when the trees are *damp, so that it sticks on well*. If it comes off by rain coming shortly after, it must be done again. It acts, of course, as a first-rate manure afterwards, causing the trees to make good wood for another year."

Another recipe for a good broadscale remedy found to work well was sent me from White Hall Farm, Chewstoke, near Bristol, as follows:—"It may be of interest to you to know how I have exterminated the 'Gooseberry Sawfly' and 'Red Spider' from my garden. For several years my Gooseberries were completely spoiled by these pests. I made a couple of hogsheads of strong lime-water, and thoroughly sprayed the bushes with it *early in the morning*.* I had an assistant to pull the bushes over, so that the liquid might reach the under part of the leaves as well as the outside. After about five minutes of this, I had the bushes violently shaken, when nearly every insect dropped off; to complete their discomfiture, directly I had done shaking the bush I had the surface of the ground freely dusted with air-slaked lime. I had this done three times, at intervals of two days, and now I have not the slightest trace of either in my garden. I find this treatment is far better in the early morning than when it is used at mid-day."—(E. W.)

LONDON-PURPLE as an insecticide.—The following detailed notes of method of (and also success of) application of London-purple for getting rid of the sawfly caterpillars are well worth attention, not only as a cheap and simple method of getting rid of this special pest, but also because, if properly used, it is as serviceable for use as an insecticide as the better known Paris-green. *Both of the chemicals are poisonous. The Paris-green is an aceto-arsenite of copper, the London-purple is an arsenite of lime; both therefore require care in use, as has been specified before.*

The great difficulty in the first use of London-purple was that in the U.S.A. (from whence, as well as in the case of Paris-green, we first learnt its value) it was thrown out as a waste product of such various strength that nothing but special trial of extent to which it might need diluting made its use safe. Here, however, we can procure analysis which

* I add the italics, as this is a very important point.—EDITOR.

saves successive trials. I have at this minute that of Messrs. Hemingway, of Mark Lane, London, before me.

The following note was sent me on May 10th, 1895, by Mr. Nixon, from Great Eversden, near Cambridge:—"With regard to the London-purple, I have used it for the last five to six years, and at the outset made sad havoc amongst my trees and foliage, in fact I killed numbers of trees by giving too strong an application. I am wiser now, and have found out the proper proportions in which to mix it. Nothing appears to me so good, cheap, or easy of application. I use Hemingway's, and mix in the proportions of 1 lb. of purple to 200 gallons of water. The purple itself should be mixed to the consistency of paste before finally mixing with the bulk of water, and this bulk must be well stirred *every time* the spraying-machine is filled, otherwise the purple will be all at the bottom, and the water at the top, the effect of which is that in some places the caterpillars are not killed, and in others the foliage is scorched (I am speaking of Gooseberry bushes).

"Our No. 86 spraying-machine, manufactured by Messrs. Boulton & Paul, of Norwich, is an excellent implement for spraying this insecticide for the reasons that for this purpose I have a return-pipe attached to the pump, so that a strong jet of the mixture is continually forced through the bulk which the tank of machine contains, thus keeping the whole, as it were, boiling and well mixed up.

"The caterpillars *are not killed the same day* the application is made. The day after some will be found dead; the second day, a good number; and the third day, as a rule, the bushes will be cleared. Many people make a grave error here. They expect the insects to be killed in a few hours after the application, forgetting that they must have time to eat the poisoned foliage, and that it must have time to do its work. Consequently they will apply a stronger mixture, which is certain to scorch the foliage, and thus they complain that purple can only be effective at such a strength as will likewise burn the foliage. This is entirely wrong, for after years of experience I can confidently guarantee that, mixed and used in the proportions and way I have named, London-purple will kill almost every caterpillar that may be present. I am proving this every day in my own orchards."—(F. N.)

To the above, Mr. Nixon added that he sent me a few Gooseberry leaves with the caterpillars on them, as he wished me to see exactly how they died. These had been syringed with London-purple in the way described at noon on the previous day (that is, just twenty-four hours from time of writing). Mr. Nixon noted that they were not quite dead

when he put them into the box, but supposed they would be when they reached me, which proved to be the case; all the specimens—that is, the caterpillars of the Gooseberry Sawfly—were dead when I received them on the following day.

From the importance of the Gooseberry crop, and also on account of the prevalence and the destructiveness of the Gooseberry Sawfly, it has seemed desirable to give more than usual space to methods which have been found serviceable in combating this infestation, but a line or two may be added as to where (judging by communications addressed to me) remedial measures especially fail.

One point that should be more attended to is *destruction of the cocoons*. If they are only scraped from beneath the bushes and thrown aside, little good will probably have been done.

Another point is that powder dressing should be thrown *so as to adhere*, that is, when naturally or artificially the bushes are damp.

And also, thirdly, sufficient attention is not always paid to the lime being hot.

The “Allied” Sawfly.* *Nematus consobrinus*, Voll.

In the year 1882 Mr. Taylor, writing from The Gardens, Longleat, Somerset, observed that, besides the common Gooseberry Sawfly caterpillar, with which he was familiar, he had noticed a smaller kind, which appeared a month or six weeks later. Like *N. ribesii*, this laid its eggs, and the caterpillars fed, on the leaves; but though in some seasons they were as numerous as those of the common kind, usually only about three hatched on each leaf.

The sample of the small green sawfly caterpillar sent me corresponded with the figure and description of the somewhat rarely observed *Nematus consobrinus*. Of this species Mr. P. Cameron † observes:—“The larva feeds in early summer on the leaves of the Gooseberry. It has a green head, marked more or less with little black points, and bearing soft hairs. The body is green, shining; the skin beset all over with transverse rows of black tubercles, each bearing a hair; the second segment, and more or less of the last, and the sides over the legs, yellow. . . . When young the head is black,

* As we appear to be without any English name for this species, of which one characteristic is its great likeness to the *N. ribesii*, perhaps the word “allied,” which fairly represents the “cousinship” of the scientific specific appellation, may be admissible.

† See ‘Monograph of British Phytophagous Hymenoptera,’ vol. ii. pp. 131–133; and figure of larva, vol. i. pl. vii. fig. 5.

the body green with black points; at the last moult it loses the black tubercles, and becomes of a bright green colour, yellowish behind the head and on the last segment.”—(P. C.)

When young, and at the final moult, the caterpillars much resemble those of *N. ribesii*, but (intermediately) comparison of description will show that there are characteristic differences.

The sawfly is given (see references in note, p. 108) by Mr. Cameron as 3–3¼ lines in length; nearly one-quarter less in length than that of *N. ribesii*, which is 3–4 lines.

The head is black, roughly punctured, covered with short pale down; portion of front of face (clypeus) white; antennæ black, more or less dull brown on the under side; thorax black, pale fulvous in front; abdomen pale fulvous, basal half black above; legs also pale fulvous, but with various markings of black and white. The above are a few of the main points observable in typical specimen as described at length by Mr. Cameron with notes of variations in colouring.

There is considered to be only one brood yearly in this country, and the cocoon is stated to be spun in the ground; but in the observations sent me from Longleat, Mr. Taylor mentioned that, unless the locality was just under the surface close to a wall or other dry place, he considered that the caterpillar preferred nail-holes in a wall, or holes in wood, for spinning up its cocoons.

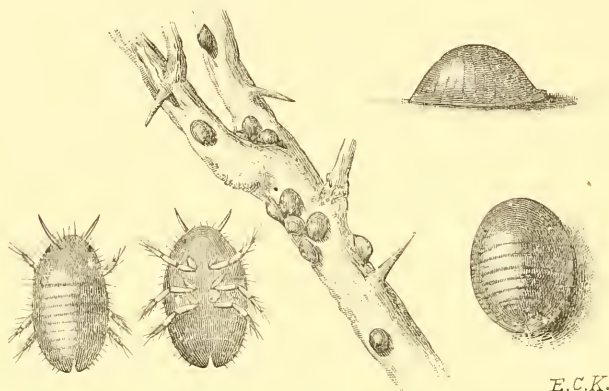
PREVENTION AND REMEDY.—The means are the same as those for the common Gooseberry Sawfly, and from the great similarity of the caterpillars of the two kinds, this species may very likely often be present together with *N. ribesii* without the difference being noticed.

Gooseberry and Currant Scale. *Lecanium ribis*, Fitch.

For several years preceding 1893 notes were sent to me from time to time, with specimens accompanying, of a brown scale insect which was found to infest branches of Gooseberry bushes to an injurious extent. It was not, however, until that year (1893) that, through the assistance of Mr. J. W. Douglas, F.E.S., I was able to ascertain the precise species of this *Lecanium*.

On the 7th of March Mr. Douglas wrote me as follows regarding the specimens which I had forwarded to him for examination:—“The scales on the Gooseberry are certainly *Lecanium ribis*, Fitch. They are familiar to me, for when I lived in Beaufort Gardens they were gregarious on the Red Currant bushes, and sometimes on the White Currant; but I

never found they did much appreciable harm. Yet in some places they are very injurious. I have known bushes to be quite exhausted by them, and once I saw an entire bush of *Ribes sanguineum* (the red flowering kind) killed by them. I never saw or heard of them on Black Currant. The male of the species is unknown. . . . I sent examples to Signoret, and he agreed that they were *L. ribis*, Fitch. I doubt, however, if the species has ever been fully described; *i. e.* only the external characters have been given.”—(J. W. D.)



LECANIUM RIBIS.—Currant Scale, female, showing side and upper surface; larval scales, with legs still visible: all magnified. Infested Gooseberry twig.

The following is the short original note of observation given by Dr. Asa Fitch, of Albany, U.S.A.:—"Currant-bark Louse, *Lecanium ribis*, n. sp., Homoptera, Coccidæ. A hemispherical scale of a brownish yellow colour, about 0.30 in diameter, adhering to the bark of the garden Currant; its margin finely wrinkled transversely. . . . This is quite common in some gardens, and I suspect has been introduced into this country with the Currant, although European authors have made no mention of a scale insect as belonging either to this shrub or the Gooseberry. It will be most readily found before the leaves put forth in the spring."*

In this country this species of scale is to be found on Black, Red, and White Currant, as well as on Gooseberry bushes, and sometimes is very injurious by sucking away the juices

* See 'Third Report of Noxious and Beneficial Insects of the State of New York,' by Asa Fitch, M.D., Albany, 1859. This account is also quoted by Dr. Signoret in his 'Essai sur les Cochenilles' (collective edition), vol. ii. p. 624 (462); and this scale insect is just alluded to by Prof. J. H. Comstock in his 'Second Report of the Department of Entomology of Cornell University Experiment Station, 1883,' in which, at p. 135, he refers his readers to the Trans. N. Y. State Agricultural Society, 1856, 427.

from the branches. In my own garden at St. Albans I have found it only too plentifully present on the stems of all the above-named bush-fruits.—(E. A. O.)

The method of life of the scale insect may be described generally, but sufficiently for practical purposes, as follows. When the soft whitish or pale-coloured lobed female, which lies without power of moving within the thin brown covering scale, is matured, she produces a multitude of minute eggs, as small as fine dust, which may easily be observed by detaching the sheltering scale. From these eggs there hatch little flattish oval maggots, or larvæ, which at first have six legs. These disperse themselves actively abroad on the boughs, and feed by inserting their rostrum, or proboscis, and sucking away the juices; presently they lose the power of locomotion, turn to the pupal state, and (to common observation) change in external appearance to the chestnut-coloured hemispherical lumps, which are commonly known as “scale insects.” This thin flexible brown covering shelters the female within; and the sequence of life-history is well given in the following note of observations sent me, on the 15th of July, from Seaford Grange, Pershore, by Mr. Wm. F. Gibbon:—

“I have closely watched the habits of the ‘Red Scale’ this season, and have verified my observations of last year. The young scale emerges from the egg early in the spring; I found them hatched out early in February, at first almost transparent, and walking with freedom on six legs; but they soon became of a chestnut colour, and assumed the shape of a small wood louse, flat and oval, and then secured a position by inserting their beak into the bark, and speedily increasing in size. When about three-fourths grown their covering appeared very shiny and sticky, and, later on, dry and harsh. In May I found the scale matured, and eggs deposited; and on the 18th of June the eggs hatched, and the young *are now* on the move, and it is at this stage of their existence to apply washes for their destruction. The young now wandering about will soon affix themselves to the bark, assume a hard covering, and mature; by autumn deposit eggs, which will hatch next spring. There are consequently two generations in a year.”—(W. F. G.)

The earliest date at which specimens were sent me in 1893 was on the 8th of February, when infested Gooseberry twigs were forwarded from near Pershore, on which were numbers of the female scales, and also of the little flat, dull reddish, six-legged larvæ already in active state.

About a month later, that is, on March 10th, I found the same species (both in female and larval condition) very prevalent on Gooseberry bushes in my garden at Torrington

House, St. Albans. The female scales were numerous on the old wood, and mainly beneath the branches, where they were sheltered from weather, and especially where the bark was often split, or had peeled away so as to expose the under surface; but (up to this date) the infestation was not noticeable on shoots of the preceding year's growth, although the larvæ and (therefore necessarily) the female scales had for some time previously been observable on the bushes.

The larvæ (or maggots) were so small as to be almost invisible to the naked eye, narrowly oval in shape, with six legs, and a pair of horns (see figures, p. 110). The colour was various, but of some shade of puce, or reddish, or ochrey tint, and the body somewhat raised along the middle so as to form a slight keel; the abdomen of the larvæ, as well as the female scales, showing a more or less noticeable caudal cleft.

The female scales were hemispherical in shape, sometimes curved slightly outwards at the lowest edge; the colour some shade of nut brown, or rich brown; the size variable, ranging from an eighth of an inch to rather more; the width about equal to the length, and the height about one-twelfth of an inch, or rather more in the middle. In the best defined specimens the border was finely ribbed transversely; the rest of the surface was so irregularly varied, according to age or condition of scale, as to make it impossible to give a precise description.

Later in the season (on the 6th of June) the female scales were plentiful on the old wood of some Gooseberry bushes which had not been particularly attended to, and in most instances were full of eggs. Sometimes the old skin of the mother scale was almost empty, but in others the quantity of eggs was astonishing, the exceedingly small oval-shaped bodies falling like a shower of white dust, which might be said to cover a space of half an inch square, and well sprinkled about an inch. The scales, which frequently contained the lobed, fleshy, greyish female *Lecanium* within them, were now of different sizes, and of various colour and condition, some being shrunken, so as to show transverse corrugations, and some plump and rounded.

About a month after (on the 11th of July) a few females were scattered on the old branches, some long dead and flattened against the boughs with the colour faded, others still bright brown and shiny. Beneath them, in some instances, eggs were still noticeable, but commonly empty eggshells were the most observable presence, together with some eggs still unhatched, and some recently hatched or hatching larvæ. And towards the end of July, though I found little larval presence on the Gooseberry bushes, I found, at the

same date, a piece of Gooseberry branch, which had been cut and kept under cover for some time, was sprinkled over with multitudes of the young larval scales. These were scattered in scores, or rather in hundreds, over every part of the branch excepting the withered leaves, but were then dead from the branch having ceased to supply requisite sap. The marked difference in amount was presumably from the young scales being washed off in out-of-door circumstances, or destroyed by rain, and also being preyed on by small insect-feeding beetles, &c., as there were plentiful remains of egg pellicles.

PREVENTION AND REMEDIES.—Looking at the manner in which the scales shelter themselves where ragged bark is peeling back on old wood, it is obvious that robbing them of these head-quarters so far as could be managed could not fail to be of service; and next to this, such treatment of the bushes as would allow of not only spraying the infested boughs, but of wash being run down them to lodge amongst rough bark, and would also allow of the oldest of the infested parts, where there was no fear of rubbing off buds, being well brushed with soap mixtures.

Much might thus be done by well considered pruning; but at the same time the pruned-off branches should be most carefully removed and burnt. The little larval scales, though hardly discernible without a magnifier, are actively on foot as early as February, and may perfectly easily wander back from the removed branches if these are left beneath the bushes.

Where Currants are trained in long rods on walls, these require attention, and perhaps a rod occasionally taken out, down to the root. In my own garden I have found the scales in patches at intervals on a length of several feet of White Currant.

In a communication from one of my correspondents, he mentioned (writing on the 20th of February) that he had had his infested Gooseberry bushes sprayed with "Chiswick Compound," and found it effectual; and in a further communication, a little more than a month later, he added, "I found the Chiswick Compound very effective in destroying scale." Probably this would be as serviceable an application as could be found, as it is a mixture of soft-soap and sulphur, which act well against these kinds of bark infestations, and it has the advantage of the sulphur becoming soluble (so as to be completely mixed with the wash) in from sixteen to twenty-four hours after the requisite amount of hot water to dilute the mixture to a safe strength has been added.

The mixture is procurable from the Chiswick Soap Company, Chiswick, Middlesex, and is very similar in composition

to a mixture used with success in South Australia (under the name of "Burford's Soft-soap and Sulphur Compound") against several kinds of bark attack, as Aphides, Red Spider, &c. Probably any of the common soft-soap washes, especially those that are mixed with sulphur and mineral oil, would be of use, and if a stronger application was needed, the following recipe for "Burford's No. 1 Kerosine Soap" might be of use:—"Take equal weights of kerosine and soft-soap and stir together in a convenient vessel, which should be placed in the sun in summer, or in a bucket containing hot water in the winter time. In from ten to twenty minutes' time the two ingredients will coalesce, when it can be diluted as required";* probably in this country the hot water would be more to be trusted to than the heat of the sun at any time of year.

To the above suggestions of preventive or remedial treatment may be added, with regard to date of clearing infested boughs in winter pruning, that it is desirable this should be done, and the scale-infested boughs cleared from the ground and burnt before the time when the larval scales will be hatching and dispersing themselves about bushes. *It should be done quite by the commencement of February.* Also it is desirable, after the prunings have been gathered up, to *stir† the surface* of the soil under the bushes, and to throw a little quick-lime, or any preventive mixture preferred, on the soil just round the stems to prevent the little scales making their way back to the branches.

N U T.

Hazel and Filbert Bud Mite. *Phytoptus avellanæ*, n. sp., Nalepa;
P. vermiformis (Vallot, Targioni-Tozzetti, Nalepa).

The mite bud-gall attack of *Phytoptus avellanæ* to the Hazel and Filbert is so very similar both in appearance of the

* The above, and other useful recipes, will be found in the 'Report on the Fusicladiums (Black-spot, Scab, and Mildew Diseases), Codlin Moth, &c.,' by the late Frazer S. Crawford, Inspector under the Vine, &c., Protection Act, South Australia. E. Spiller, Government Printer, Adelaide.

† In mentioning that stirring the surface-soil and throwing on quick-lime is useful, I most particularly wish to observe that I do *not* advise "deep digging" under the bushes as a preventive measure for this or any other Gooseberry attack. As far as I am able to form an opinion, such a measure would be injurious in the extreme to the roots of the Gooseberry bushes.—(E. A. O.)

Phytoptus which causes it and also in that of the abortive, swollen, and mite-infested buds to that of *P. ribis*, figured at p. 60, that it is unnecessary to give a special illustration. Like it, the mite is too small to be distinguished by the naked eye. The life-history of the two species is similar.

It belongs to the great order of *Acarina*, but, together with the others of the genus *Phytoptus*, is distinguishable by its cylindrical shape gradually lessening towards the tail extremity; and also by only possessing throughout its life, from the time of hatching from the egg, two pairs of legs placed near the head extremity behind the somewhat conical-shaped feeding-apparatus. The above peculiarities distinguish the genus *Phytoptus* clearly from others of the *Acarina*, of which the Red Spider of the Hop may be taken as an example, which have a more or less oval or rounded shape, and, as a rule, four pairs of legs during all their life, excepting in the earliest stages, when they have three pairs.

The shape of the female and larva is cylindrical; that of the males, when arrived at the stage of sexual development, not unfrequently spindle-shaped. The length of the female may be as much as twenty-one hundredths of a millimetre (0·21 mm.); of the male eighteen hundredths (0·18 mm.); the breadth from four hundredths of a millimetre to much less (0·04–0·065 mm.); and a millimetre being a twenty-fifth part of an inch, it is commonly more by the characteristic deformed growth of the buds than by identification of the species of the mites that the attack is known.

As in the case of the Black Currant infestation the development of the bud lengthways is checked, and it forms a more widened spherical growth, with an abnormal number of bud scales and abortive leaves; these, consequently on the abnormal development of the cellular tissue, are thickened and more or less sprinkled with hairs or other excrescences. These deformed buds may be found early in the spring, even before the Hazel leaves show themselves, and at this time the leaves, or scales of the buds, are already for the most part plentifully sprinkled with *Phytoptus* eggs. Later on the buds dry up, and fall, having been previously deserted by the Gall Mites, which are now mostly to be found in the newly formed leaf-buds.

With the second growth of the shoots of the Nut bushes in July and August, a second growth of deformed buds is again observable, distinguishable by their remarkable size and green colour.

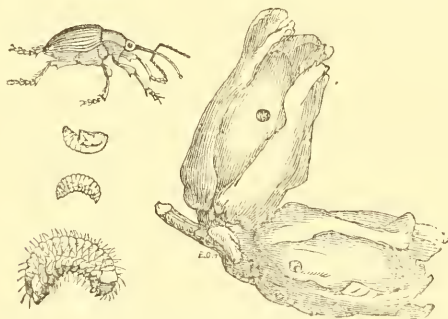
This infestation has been so rarely reported that I have had little opportunity of studying it myself, and the above observations are chiefly taken from those of Dr. A. Nalepa,

given in the work referred to below, in which will also be found detailed descriptions of *P. avellanæ*, together with references to the bibliography of the subject and various synonyms given by different writers.*

In the few cases which I have myself seen of presence of Gall Mite infested buds on Filberts, one of the worst instances was where the bushes appeared to have been neglected for some years, and were overhung by trees. Also the galls were numerous some years ago on Hazels on a hedge in a very damp locality near St. Albans, with a Willow-ground and stream close by, and much overshadowed by trees.

PREVENTION AND REMEDY.—The means would be the same that are being tried in the case of Black Currant attack, and especially *destroying infested shoots or bushes*.

Nut Weevil. *Balaninus nucum*, Linn.



Nut Weevil, magnified; natural length 3-5 lines; pupa, natural size; maggot, natural size and magnified; bored Filbert.

The trouble of “maggotty” Nuts, which is only too well known both to growers and to eaters, is caused by the larva of *Balaninus nucum*, commonly known as the “Nut Weevil.” This is a small beetle, of the shape figured above, and only about a third of an inch in length, including the proboscis. The colour varies a good deal, but it may be generally described as of a tawny brown colour, densely clothed with short depressed hairs, or greyish or yellowish down; the proboscis,

* ‘Beiträge der Systematik der Phytopen,’ von Dr. Alfred Nalepa, pp. 15-18, pl. ii. figs. 1, 2, 3, and pl. iii. fig. 3; Wien, 1889. Information will also be found regarding the infestation under the synonym of *Phytoptus coryligallarum*, Targ., in the ‘Prospetto dell’ Acarofauna Italiana’ of Prof. Giovanni Canestrini, parte v. p. 611, tav. 52, fig. 9; Padova, 1892.

which is a third or more of the length of the beetle, is fine, arched in shape, and of a bright chestnut colour, with one of the pair of elbowed antennæ on each side, and furnished at the extremity with jaws. The colours are very variable, but the great length of the proboscis is a marked distinction.

These beetles, or weevils, may be seen about the Nut bushes early in the summer, the females usually creeping along the twigs, the males often on the wing. Whilst the Nuts are still young the female pierces a hole through the soft shell by means of the jaws with which she is furnished at the end of her long snout. In this hole she lays one egg, which hatches in about ten days. The maggot feeds inside the Nut, consuming a large part of the kernel. When full-grown it is of the shape and size figured at p. 116, fat, fleshy, and cylindrical, slightly attenuated in front, and curved under at the tail extremity; of an ochreous white, with round horny chestnut-coloured head, furnished with strong black jaws; without legs, but supplied with muscles inside the large transverse folds or wrinkles, which enable it to draw itself through the earth.

When full-fed the maggot eats a hole through the Nut shell, sometimes whilst the Nut is on the bush, sometimes after it has fallen to the ground in the premature ripening which appears to follow on the maggot-attack. It then buries itself, forms a cell in the earth, and "frequently rests there during the winter, and only changes in the following spring or later" to a pupa or chrysalis of whitish colour, like the future weevil in shape, but lying quiescent with its limbs folded against it.

The weevils may be found as early as May, at which time development from the chrysalis has been recorded, but it is stated that some of these beetles do not develop till July or August, and it is still open to observation whether some of these do not hybernate and appear with those newly out of the chrysalis in the following May.

PREVENTION AND REMEDIES.—Very few observations have been contributed with regard to this attack, or means of prevention and remedy; but one regular method of treatment which has been recommended when weevils are abundant on Nut bushes, is to *beat* them down, but this should not be done on a sunny day, or they will speedily take flight and escape; and (saving for treatment of a bush or two) probably the only way to carry out the plan of beating serviceably would be either to put tarred boards, or for one man to throw a sprinkling of quick-lime or gas-lime under the Filbert trees whilst his companion beats down the weevils.

It is desirable to remove all Nuts that fall before their proper time and *burn* them, so that the maggot inside may thus be carried away and destroyed before it has bored its way out; and also, looking at the powers of flight of the weevils, it would be well not to have many Hazel Nut bushes in copses adjacent to Filbert ground.

But probably with this infestation the best methods of prevention lie in the regular measures of *good cultivation*. It is stated the Filbert likes a Hazel loam of some depth, which should be dressed every year, as the Filbert requires a considerable quantity of manure. Also that "in Kent the Nut grounds are well manured every other year with rags, shoddy, fish, or fur waste, and are always cultivated by hand, and kept scrupulously clean."

This course of treatment, that is, treatment which involves stirring the surface-soil as well as giving additions wholly foreign to insect nurture, is suited to expose some of the chrysalids and bury others deeper, and is generally useful for insect prevention, but especially as regards the Nut Weevil, which (in instances observed) has been found to be so tender at the time of its transformations as to require eight or nine days to gain its colour and hardness, and also strength enough to force its way up through the ground. Looking at these points, it seems likely that if the chrysalids were buried a little beyond the natural depth many of the weevils from them would not be able to come up at all.

Nut Leaf-Weevil. *Strophosomus coryli*, Fab.

On May 15th, 1889, a large number of beetles were forwarded to me by Mr. A. L. Y. Morley, from Great Brington, Northampton, with the observation that Lord Spencer's forester had just brought them as specimens of insects which were doing considerable damage in that neighbourhood to plantations of young Larch, Scotch Fir, and Corsican Pine. Amongst these the Pine Weevil (*Hylobius abietis*) was present, but also there were numbers of a little brownish short-nosed weevil, only about the fifth of an inch in length, and marked with a little black stripe running from the base of the wing-cases half-way along the suture.

On examination, these small beetles proved to be *Strophosomus coryli*, Fab., of which Dr. Taschenberg remarks as follows (see 'Praktische Insektenkunde,' pt. ii. p. 103):—"This beetle appears in many years in great numbers, not only on Hazels, as might be inferred from its scientific name, but also on Birch, Oak, Beech, Scotch Fir, and Pine, where

from May until the middle of June they feed on the buds and leaves and the bark of the young shoots, and in various localities have destroyed young trees of the above-mentioned kinds. In the middle of June pairing takes place on the plants. The larvæ live in the earth; any injury caused by them is, however, still unknown.”—(E. L. T.)

As this little beetle is hardly the fifth of an inch in length, a figure would not be of much assistance for general purposes; but it may be described as not unlike the nearly allied Pea and Clover Leaf-Weevil (*Sitones*) in general shape; black in colour, but so closely covered with grey and brownish scales as, excepting where these are rubbed off, to be mostly of a brownish colour; rostrum short; antennæ elbowed and rust red; legs also rust red; wing-cases with stripes of punctures and rows of bristles between them, stripe at base of the suture of the wing-cases black (this is an important characteristic); wings none.

The above is the only occasion on which *S. coryli* has been sent me as an injurious infestation; but in Stephens's 'Manual' (p. 245), it is mentioned as occurring in this country “on Hazel; generally distributed”; and Kaltenbach,* in his German observations, notes that “this injurious weevil-beetle appears in the spring for the most part in great numbers, and gnaws the leaves of Hazels,” &c. Therefore it seems worth while to note its presence, and more particularly as some doubt has been expressed as to the kind infesting Pine being more probably the smaller species, *S. obsesus*, Marsh., than *S. coryli*. But though the kinds are very similar, there are distinctive characteristics, and in those sent me from the Coniferæ near Northampton, the kind being *S. coryli*, Fab., was not open to doubt.

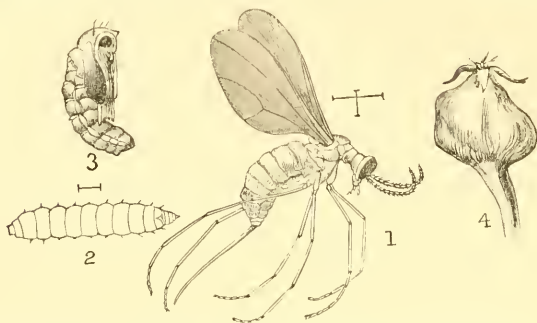
REMEDY.—The only remedial measure known appears to be beating down the beetles and destroying them.

OBSERVATION.—In the ‘Arboretum et Fruticetum Britannicum’ of the late J. C. Loudon the Nut is mentioned as being attacked by numerous species of insects. Amongst these, the attacks of caterpillars of about thirteen species of moths, seventeen beetle attacks, and various others, as of Plant-bugs, Aphides, &c., are mentioned by name; but from whatever cause (possibly from improved methods of cultivation allowing less shelter to the insects) so very little complaint is sent regarding insect infestation to this crop, that it seems fair to suppose that the injuries are not now to such an extent.—E. A. O.

* ‘Die Pflanzenfeinde,’ p. 590.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra*?, Meigen and Schmidberger; *C. pyricola*?, Nordlinger.



DIPLOSION PYRIVORA.—Female, magnified; lines showing nat. size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

The Pear Gnat Midge is a very frequent trouble to Pear growers from the damage caused by its little legless, yellowish white maggots living in numbers inside the young Pears in their very early condition. Consequently on the maggots feeding within, the growth of the young Pears is checked and stunted, the centre decays, and the fruit cracks or dies, and drops off.

This attack was first reported to me in 1883, with good specimens of Pears having their growth aborted by the infestation sent accompanying, some of which I was favoured with on June 15th by Lord Walsingham from one of his farms in Norfolk. These consisted of small abortive Pears, then in process of being eaten away by the small white legless maggots within, and information was sent with these samples of attack that every Pear on the trees from which they were taken was infested by them.

Amongst various characteristics of these larvæ, the faculty of skipping (like cheese-maggots) in every direction—a power which they make use of in springing from the Pears on which they have fed to the ground—was very noticeable.

A little earlier in the same year (on June 4th) an account of a similar attack (also mentioned as not previously observed) was sent me, with specimens accompanying, from Llanina, New Quay, South Wales, by Mr. C. K. Longcroft, with the observations:—"I have sent you some specimens of Marie Louise Pears, of which there was a splendid promise of a crop

on two trees, but they are all attacked by grubs within. If you cut one open you will see the culprits. The same thing happened last year, causing the destruction of a crop, as well as in addition having destroyed a fine crop of Beaune Bachelier. . . . I have not heard of a similar case in this neighbourhood, and during my previous experience of many years I never met with or heard of their appearance here.”—(C. R. L.).

This Pear attack has long been known on the Continent, and is described in Kollar's 'Insects,' published in 1837 in Vienna (English translation, with notes by Prof. Westwood, published in 1840); but with one exception of some affected Pears noticed by Mr. H. Reeks, of Thruxton, in 1874 or 1875, the attack does not appear to have been noticed in Britain until the observations sent me in 1883, of which Mr. R. H. Meade, F.E.S., remarked that my article on the Pear Midge in my 'Report of Observations of Injurious Insects for 1883' was, so far as he knew, "the first recorded notice of the insect in this country."*

Still, though the attack was well known in Germany, and had become known here, there was great uncertainty as to the technical entomological appellation which was to be accepted for this Pear Gnat Midge; and we were greatly indebted to the careful observations of the Rev. E. N. Bloomfield, of Guestling, near Hastings, who in 1885 enabled us to clear up what was wanting in the life-history to determine the name.

From consultation over Mr. Bloomfield's specimens by skilled referees, amongst whom I may mention the well-known entomologists, Mr. R. H. Meade, Mr. Peter Inebald, and Mr. E. A. Fitch, there was no doubt that our newly-observed Gnat Midge was identical with the species first recorded as injurious in the U.S.A. in 1884, and determined by Dr. C. V. Riley, Entomologist of the Board of Agriculture of the U.S.A., as *Diplosis pyrivora*.

This attack is considered to have been imported into America on Pear-stocks from France in 1877, and so far as evidence points was also a foreign importation to this country. Here, however, it is only occasionally complained of as troublesome, whilst in the U.S.A. its spread was extraordinarily rapid.†

The "midge" which causes the mischief is a very small two-winged gnat-like fly, only about one line (the twelfth of

* See *Diplosis pyrivora*, Riley; "The Pear Gnat," by R. H. Meade, F.E.S., the 'Entomologist,' vol. xxi. pp. 123-131.

† See, for much useful information on this attack, "The Pear Midge (*Diplosis pyrivora*, Riley)," Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

an inch) or a little more in length of body; the general appearance greyish or black. More in detail, when seen much magnified, and as described by Mr. Meade from his own very complete observations, the head is black, with a patch of yellow hairs, on the top of which some come forward over the eyes. Antennæ (horns) yellowish brown, in the male about one-fifth longer than the whole length of the insect, in the female "about two lengths of the insect without the oviduct." Thorax (body between the wings) black, and, like the face, with grey reflections; and seen "from before the hind part looks ash-grey, while the front part appears divided into three wide black stripes or patches, of which the middle one is triangular in shape, with a broad base in front, and tapering to a point behind where it joins the scutellum." On each side between the central and side black patches is a row of bright yellow hairs; but "viewed from behind, the whole



Wing of *D. pyrivora*,
magnified.

thorax looks grey." A long tuft of yellow hairs is placed above and in front of the root of each of the wings, and the front edge of the thorax is covered with short yellowish hairs. Abdomen dark brown, clothed with long whitish hairs. Halteres (poisers) with yellowish stalks and clear white

knobs. Wings dusky, clothed and deeply fringed on the hind margins with black hair. Legs brown, clothed with white hairs, more dense on the under surface.*

I have never seen deposit of the eggs myself, but the method of operation is stated to be when the Pear blossom-buds are so far advanced as for a single petal to show itself, for the Pear Midges to deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud. They were also seen by Schmidberger, the chief authority on method of egg-laying, to pierce the outside of the blossom with the ovipositor. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail, with a small horny appendage, known as the breast-bone, or (from its form

* For full and very clear description of the imago or perfect Gnat Midge of the *D. pyrivora*, from which I have, with many thanks, extracted the above few points, see paper on "*Diplosis pyrivora*," by R. H. Meade, in the 'Entomologist,' vol. xxi., previously referred to.

in some of the *Cecidomyiæ* larvæ) as the "anchor process," beneath the fore part of the body near the head end. In the Pear gnat-maggot this process consists of a narrow stalk attached at its base to one of the segments of the little larva, and pointing forward at the free end, which is enlarged to nearly twice the width of the stem, and slightly notched at the flattened or convex end. The anchor process is of a horny texture, and brownish or pink in colour.

The maggots have a wonderful power of jumping by bending so that head and tail meet, and then taking skips in all directions, a habit which is very noticeable if they chance to be under examination on a coloured tablecloth.

Within the young Pears the growing *Cecidomyia* maggots live and feed till they have attained their full size. This will be somewhere about the beginning or middle of June, by which time much of the inside of the little Pears will have become black and decayed, consequently on their ravages, and the fruit stunted in growth, and probably cracked. The infested Pears may often be known by their knobbed irregular growth, but not always; some that I have had have not shown characteristic damage outside; also the size that they may grow to varies. In the eight figures now before me, given in the paper by Prof. John Smith on this infestation, none of the Pears are as much as an inch long, but they may reach as much as one or two inches in length.

At this stage the Pears crack or fall to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting again from Prof. J. B. Smith as, I believe, our most recent observer) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring."—(J. B. S.). There appears to be a difference in date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the gnat-midges come up out of the ground in spring ready to attack the blossom-buds of the Pear.

During the present year (1898) the attack, judging by amount of enquiries sent, appears to be more than usually prevalent; and about the 28th of May, whilst these notes were passing through press, I received specimens and some observations of a remarkably bad attack in the neighbourhood

of Evesham, the crop being consequently (from both the earlier and later blossoms) a complete failure.

The specimens sent me consisted of bunches of little Pears, about from three to five in a bunch; the size of the largest of the Pears about five-eighths of an inch across by three-quarters long. Many if not all of the Pears were distorted in growth, some lumpy or knobbed, some swelled on one side and contracted on the other, so that the "eye" was quite drawn to one side. Of these I cut open fifteen or more which showed infestation. The maggots within were of various sizes, from about two-thirds to apparently full grown, and were lying in the gnawed and blackened middle part of the Pear, which was not as yet eaten away, but chambered by their galleries. The centre round the core and the part between this and the calyx end was the portion infested, but not the part towards the stem end.

It was difficult to count the number of maggots with certainty that might be in one Pear, but by careful examination I found up to about a dozen in the half of one Pear cleanly separated from the other part. The maggots were in very active condition, and dispersed themselves freely on the paper on which some of the Pears were laid, as if endeavouring to bury themselves.

But perhaps the most interesting point observable was the gradual development of the marking of external discoloration of the skin, which appeared to be the gradual advance of injury to the cracking open, often accompanying the completed stage of destruction of the young Pear from this attack. In the first stage the markings were merely of little black or blackish patches on the outside (*not* as far as I could see connected with internal injury), but gradually the patches became roughened on the surface, and small splits appeared across them, which in the more advanced specimens were deepening into small but decided cracks, which it might be presumed were the beginnings of the deep fissures often occurring in the fully destroyed Pear, and through which many of the maggots make their escape to the ground. The black spotting would be well worth practical observation, as a guide to which Pears were in an early stage of infestation and might be destroyed before there was any chance of the maggots within escaping to cause recurrence of mischief.

PREVENTION AND REMEDIES.—For preventive measures it does not appear that any are more available than the following methods of treatment:—

In cases where the crop is in reach, to pick off and *destroy* (not merely throw aside) the little stunted Pears, and also to

pick up, as soon as possible, and destroy the small fallen fruit. To this the treatment of giving a thoroughly good shaking and jarring of the boughs of the infested tree, so as to shake down as much of the infested fruit as possible, *as soon as possible*, would probably be a very serviceable addition. Also if previously tarred cloth, or any rough cheap material, was spread under the boughs of the tree, so that the infested fruit and the maggots which escaped from it might all be gathered up together and burnt, or well shaken out together into a hole and well covered down, this would save much escape of the maggots. Also spreading a coat of quick-lime on a *dry day* beneath the infested tree, and then slaking it, might have a very good effect, and the lime would kill many of the escaping maggots.

Where Pears are grown in grass orchards, a deal of the fallen infested fruit would be cleared off by having sheep on the ground ; and where the ground below the trees is free of crop, and the Pear roots not too near the surface, the plan of skimming the surface and destroying the surface earth with its contained infestation would answer well.

The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed ; but I would on no account whatever advise the treatment which I see at times recommended in this country with regard to clearing infestation from soil under trees or fruit bushes, namely, that of *digging the ground*. Such treatment is absolute destruction to the surface roots, a large proportion of which lie much nearer the surface of the earth than a spade's depth ; and also, although some of the cocoons may be buried down so as to be put out of the way of doing mischief, yet a large proportion are only scattered about in the soil, and the insects develop from them as safely as I have known them to do where the infested skimmings from under Gooseberry bushes were laid in rows between the rows of plants.

It should perhaps be noted with regard to this attack that the only connection it has with the Pear tree is with the blossom-buds for the purposes of egg-laying, and with the young fruit, in which the maggots feed until, at their maturity, they quit the fruit and bury themselves in the ground to go through their changes to the complete gnat-midge. Therefore the washings, or lime dustings, or scrapings of the trunk of the tree, which are so very serviceable in cases of various other Pear or Apple attacks (notably that of Codlin Moth) are of *no use at all* with this infestation.

In the observations sent me on May 25th, 1896, by a correspondent of a bad attack of the midge-maggots on his

young Pears at Carnforth, Lancashire, he mentioned that he had dusted the trees with lime, and also sprayed with Paris-green, *without any good effects*; but relatively to the latter application, it has been suggested that where attack is very bad indeed, so as almost certainly to involve losing all the young Pears, that it might be worth while to spray so strongly with Paris-green, or some other arsenite, as to blast the fruit, and thus prevent the contained maggots coming to maturity and continuing the attack. This would be a point for consideration of the grower.

The best remedy of which we have information at present appears to be (as reported by Prof. J. B. Smith) application of kainite to infested ground. In an observation on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination, it was found that of one kind especially grown fifty per cent. were "mided," and of the other kind named not one could be found to have escaped.

In laboratory experiment Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of the nitrate was applied, a still lesser proportion of the maggots were found to be alive.

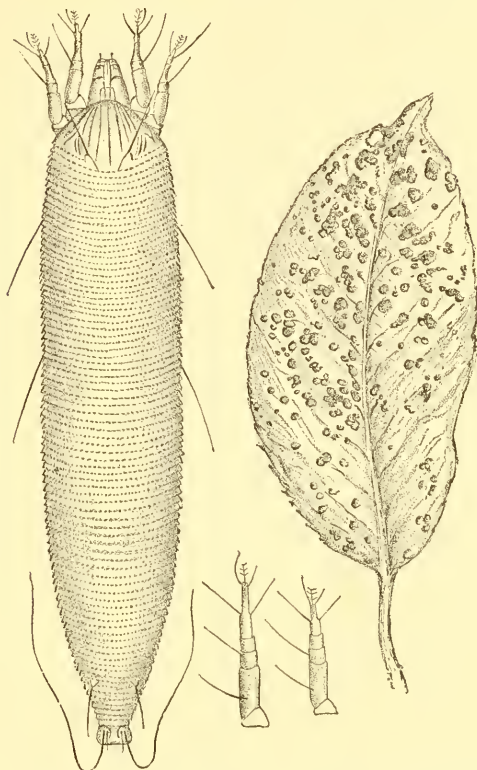
Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

But in the case of sprinkling with a small quantity of kainite, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in the jar had ever formed cocoons, and those that did seemed all of them to be dead."—(J. B. S.).

The experiment is given in minute detail in the Bulletin previously referred to,* the period from commencement to final examination ranging from June 10th to Oct. 6th, and I believe may be of great assistance to us in checking attack of this destructive gnat-midge.

Addendum (June 7th, 1898). — For further observations, taken from examination of advanced stage of attack, see Appendix.

* See note, p. 121.

Pear Leaf-blister Mites. *Phytoptus pyri*, Nalepa.

PHYTOPTUS PYRI.—Female, nat. length circa 0.2 mm. ; left leg of the first pair of *P. tristriatus*, and (smaller figure) of *P. tristriatus* var. *carinea*, magnified 550 times—all after Dr. Nalepa. Infested Pear leaf.

The Pear-leaf disease, known as “blister,” which is caused by a minute cylindrical four-legged mite (or *acar*us), figured greatly magnified above, does great harm to Pear leafage in some places in this country, and likewise on the Continent of Europe, and in the United States and Canada.

The disease shows itself in the form of blister-like spots somewhat raised on each side of the leaf, and in the middle of each little blister beneath the leaf is a little hole, which gives access to the central cavity, and also gives passage out at pleasure to the mites. The spots or blisters may be found on the Pear leaves whilst they are still quite young ; but later on, when the leaves are expanded, is the period at which they are most noticed. They may be red or green, or red on one side

of the leaf and green on the other ; and later on, presumably from death of the diseased tissues, the blisters turn blackish or brown in colour.

Some confusion is apt to arise between these blisters and the small discoloured patches of mere vegetable disease often found on Pear leaves, and sometimes known as Pear Scab ; but a little examination with a hand-magnifier, so as to distinguish the swelling of the blister on *both* sides of the leaf, and the *central hole below*, and if a section is cut, the disorganized tissue with something of a cavity between the two sides of the blister, with very possibly the cylindrical gall-mites within, will show the difference.

With regard to the Phytoptus pyri, the Leaf-blisters Mite, or gall-mite, which causes this attack, it is almost or quite invisible to the naked eye, being very much less than one millimetre in length,* and its breadth only about one-fifth or sixth part of its length. The greatly magnified figure at p. 126, copied by kind permission of Dr. Nalepa from one of his excellent figures, shows the shape perfectly. It is cylindrical, tapering at the tail, with a strong slightly curved proboscis, and four legs, which are distinctly jointed ; the terminal claw, variously known as a "holding-claw" or "feather bristle," is four-branched. The abdomen is uniformly ringed, and rather finely punctate. Without very strong microscopic power, far beyond what most of us possess, it is impossible to identify one from the other the different species of *Phytoptus* ; but with this Pear Leaf-blisters the attack may for all practical purposes be identified by the existence of *the blister* ; and with moderately strong magnifiers the mites may be distinguished as gall-mites, or as of the subfamily of *Phytoptidæ*, from others of the order *Acarina*—to which they belong—by their narrow cylindrical shape, and by having *throughout their lives only two pairs of legs*. They are hatched from the egg with two pairs, placed as shown in the figure at the fore part of the body, and they *never* have more. This is a most important point to be attended to, as, for want of knowledge of this fact, observations are at times hopelessly confused as to what kind of infestation is present, and consequently what treatment needed.

This Pear-leaf infestation is not often enquired about, but personally I have had it more or less under observation since the year 1876, and whenever I needed specimens have been able to find them on the Pear leafage in the garden I occupied for some time near London, and later on here at St. Albans.

In the year 1893, in which mite-galls caused by *Phytopti*

* As previously mentioned, one millimetre is the 25th part of an inch.

were unusually observable, enquiries were sent from various correspondents regarding this attack, and in the following year enquiries were also sent from localities respectively in Kent, Surrey, and Somersetshire; but, excepting the observation that in one instance even the very young leaves which had not yet uncurled appeared affected on the two trees examined, the notes gave no additional information as to appearance of the attack.

The following notes, taken partly from Canadian and partly from German observations, give the life-history of the infestation in short plain form, available for practical service. The first is by Dr. J. Fletcher, Entomologist of the Department of Agriculture, Ottawa, Ontario, Canada:—

“PEAR LEAF-BLISTER MITE, *Phytoptus pyri*.—An insect which is giving a considerable amount of trouble in Canada at the present time [1892] is the Pear Leaf-blister Mite. . . . The mites, which are hardly visible with the naked eye, emerge from the scales of the leaf-buds early in spring, and attack the tissues of the unfolding leaves. The blisters soon begin to show as small red spots, each of which has a small central hole on the lower side of the leaf. The eggs are laid inside these blisters, and the young, escaping through the central opening, at once form new galls, until sometimes the greater part of most of the leaves is rendered unfit to perform its functions.

“When mature the galls are brown and spongy in texture, and are raised perceptibly above the surface of the leaf. Before the leaves fall the mites leave the galls, and secrete themselves beneath the scales of the winter buds, where they remain throughout the winter.”*

All of us who are troubled by these blisters on our Pear leaves can see for ourselves that the attack may go on spreading throughout the summer, but the following notes by Dr. E. L. Taschenberg give special details. He observes that the “sexually developed mites move about fairly nimbly on the under side of the leaves. They are found throughout the whole year, from May onwards, of various ages, and have many broods; so that multiplication continues uninterruptedly until the winterly season. They disperse themselves, both as larvæ and developed mites, in the leaf- and flower-buds of the one-year-old twigs, embedded in the felt-like layer of hairs on the inside of the outer bud-scales.”†

And again, with regard to their condition during winter, Dr. Taschenberg mentions:—“This they pass as larvæ, or as

* From “Report of the Ontario Fruit Growers’ Association,” p. 113, published in the ‘Annual Report of Dept. of Agriculture of Ontario for 1892.’

† ‘Praktische Insektenkunde,’ von E. L. Taschenberg, pt. v. pp. 159, 160.

sexed individuals mixed together in the leaf and flower-buds of the one-year-old shoots, embedded in the layer of hair or downy felt inside the outer bud-scales, commonly many together; Herr Sorauer has found as many as seventeen." (See *loc. cit.*)

PREVENTION AND REMEDIES.—Where there are only a few leaves infested, or the trees are small, it is well to pick these leaves off and *burn* them as soon as attack is observed. Also, looking at the observation of Dr. Taschenberg that the infestation has been found to begin its yearly course on the lower leaves of the twig, *whilst the upper are still free*, it would appear that if special attention was directed to clearing these leaves it would very much help in checking attack.

In Dr. J. Fletcher's paper, quoted at p. 129, it is mentioned that up to that date kerosine emulsion seemed to be the only application which had given promising results as a remedy; and amongst reports sent to myself I had the following good note of success of use of kerosine emulsion in checking Pear leaf-blister damage, sent me early in May, 1894, from near Southampton. My correspondent wrote that he had lost no time in applying some kerosine emulsion to the injured trees by means of a knapsack Strawsonizer. "This has certainly arrested the damage on those trees that were only slightly affected as yet, and I am in hopes it may yet save the four horizontally trained Pear trees, which on receipt of your letter had hardly a sound leaf left, the tender young leaves being all rolled up; for the new leaves that have formed since the application of the emulsion are so far looking healthy."—(F. K.).

In my own garden I have had thoroughly good success in checking this attack by having "antipest," which is a preparation very much of the nature of kerosine emulsion (see Index), on the blistered leafage. But for broadscale service, in destroying the mite when it is in its winter quarters, the treatment of effect of kerosine emulsion as carried out at Cornell University Agricultural Station, New York State, U.S.A., proved so satisfactory that I insert the following summary of the operations. The experiments were carried on in 1892, and repeated for verification in 1893, and the main points regarding the treatment, which proved very successful, and the life-history of the pest, were embodied in the pamphlet mentioned below, which may be strongly recommended to all interested in the subject.*

* Bulletin 61, December, 1893. Cornell University Agricultural Experiment Station. By Mark Vernon Slingerland. Published by the University, Ithaca, New York, U.S.A. Procurable through Messrs. W. Wesley & Son, Essex Street, Strand, London, W.C.

After various experiments at Cornell University Agricultural Station, two trees were chosen, of which one was treated with kerosine emulsion diluted with two and one-third parts of water, the other tree left untreated as a check. "In the spring the mites appeared in force on the check tree, but upon the treated trees* not more than a dozen galls appeared during the season, the pest having thus been nearly exterminated!"

This was looked on only as a guiding experiment, and carried on in the following year on a larger scale, as follows:—

"In September" (of the first year of observation, 1892) "we found sixteen quite badly infested trees in the Horticultural Orchard here at the Station. These were then labelled, and on March 10th, 1893, all but two (which were left for a check) were sprayed with kerosine emulsion diluted with from three to ten parts of water. The trees were standards varying from six to fifteen feet in height; but it was found that it required only about one and a half quarts of the diluted emulsion, and about two minutes of time, to spray a tree thoroughly from all sides with a knapsack sprayer.

"July 10th, 1893, the trees were examined, and it was found that the four sprayed with the emulsion diluted with three parts of water were practically free from the disease.

"The four trees sprayed with the emulsion diluted five times, and the four on which the emulsion diluted with eight parts of water was used, showed a very few galls—not one per cent. of the number on the trees the preceding year.

"Two trees which had been sprayed with the emulsion diluted with ten parts of water showed nearly as many galls as before.

"The two check trees were as badly infested as they were the year before."

From these experiments it appears, as summarized by Mr. Slingerland, that the Pear Leaf-blister Mite can be nearly exterminated by *one spraying* of the Pear trees (at any time after the leaves have fallen off in the autumn, and before the buds have begun to swell in the spring) *with kerosine emulsion* diluted with *not more* than five to seven parts of water—the tree being sprayed thoroughly from every side, taking especial care to hit every terminal bud, for this is where most of the mites congregate.—(M. V. S.).

* "Trees": two trees were dressed with undiluted kerosine, and nearly killed, thus showing the necessity of being very careful in the use of kerosine; but as the dozen leaf-galls mentioned above were all to be found on the three trees, the modified strength given in the emulsion answered well. "The only apparent effect upon the trees treated with the emulsion was a slight retardation in the unfolding of the leaves in the spring."—(M. V. S.).

OBSERVATION.—The figures of the left leg of *Phytoptus tristriatus* and of *P. tristriatus* var. *carinea*, magnified 550 times, at p. 127, are given in order to show the form of the “holding-claw” or “feather-bristle” of the *Phytoptus* on somewhat larger scale than it is shown in the figure of *P. pyri*; and whilst I refer readers desiring complete description and perfect representation of the gall-mites to the works mentioned below, I desire to record my sincere thanks to Dr. Nalepa not only for his permission to make use of his figures in my more detailed papers in my Annual Reports for 1893, 1894, and 1896, but also for being so very good as to identify for me all the specimens I sent over, and to assist me with valuable instruction as to the anatomical and structural formation of *Phytopti*.

Those who wish to study the most recent publications on Phytoptal observation in Austria, Italy, or France, will find a list of these in the ‘Katalog der bisher beschriebenen Gall-Milben ihrer Gallen und Nahrpflanzen, nebst Angabe der einschlägigen Literatur und kritischen Zusätzen.’ Zusammengestalt von Prof. Dr. Alfred Nalepa, in Linz-u.-Donau. Abdruck aus der Zoologischen Jahrbuchern (Gustav Fischer, in Jena).

The publications by Dr. Nalepa, from which I have quoted in the preceding paper, are: the ‘Beiträge z. Syst. d. Phyt., Sitzgsb.,’ 1889, 98 = ‘Beiträge zur Systematik der Phytopten, in Sitzungsber. d. Kais. Akad. d. Wiss. in Wien,’ 1889. Bd. 98, 1, 1889; also, ‘Zur Syst. d. Phyt. Sitzgsb.,’ 1890, 99 = ‘Zur Systematik der Phytopten, in Sitzungsber. d. Kais. Akad. d. Wiss. in Wien,’ 1890. Bd. 99, 1.

The first-mentioned in the two above paragraphs are separate impressions from the Reports of the Imperial Natural History Society of Vienna, to which the reference follows each title, and I give both references, as the cost of the pamphlets—3s. 6d. or thereabouts—is very considerably less than that of the volumes of the Reports or Transactions of the Imperial Society.—E. A. O.

Wood Leopard Moth. *Zeuzera asculi*, Linn.

The caterpillars of this moth feed in the live wood of many kinds of trees. They are to be found in Pear, Apple, Plum, and Walnut; also in Ash, Beech, Birch, Elm, Holly, Lime, Oak, and others, besides Horse Chestnut (*Æsculus hippocastanum*), from which the moth takes its specific name, though not appropriately, as it rarely attacks this tree.

The moth is said to be native of almost all Europe, and is widely distributed in this country, and specimens of this attack, chiefly in caterpillar stage, are not unfrequently sent me, but it is very rarely mentioned as being prevalent. In 1879 it was more common than usual near Maldon, in Essex; and, during severe weather in the winter of that year, a few specimens of caterpillars were brought to me in small boughs, or rather in thick twigs, at Isleworth (near London), quite



ZEUZERA ÆSCULI.—Female, head of male, and caterpillar.

uninjured by the cold. In 1880 it was noticed as very numerous at Craighall, Blairgowrie, Perthshire, many empty pupa-cases being observable in young Poplars at the water's edge; and it was also observed in that year as very injurious in fruit and timber trees at West Ham, in Essex (so that measures were taken to destroy the caterpillar); but excepting these observations no notes have been sent of it up to the present time as a serious infestation.

The moth is large and handsome; the female from about two and a quarter to two and three-quarter inches in spread of the wings, the male much smaller. The wings are somewhat transparent, and are white with blackish or blue-black spots, the spots being darkest on the fore wings, which also have yellow veins. The body between the wings is white spotted with black, and the abdomen grey, or grey banded with black.

It is stated that the female moths appear somewhat later than the male, and may be found until the end of August.

The eggs are laid during July, or later in the summer, in crevices of the bark, and on the branches as well as the trunk of the trees; these eggs are oval and salmon-coloured, and as many as three hundred have been seen laid by one moth.

The caterpillars, which soon hatch, feed at first in the bark, but not long afterwards they make their way into the live wood, where they bore galleries rather wider than themselves, and as much as a foot in length. When full grown they are about an inch and a half long, whitish, or yellow, or ochry, with a black horny plate on the segment behind the head, and the tail segment also is partially black and horny. The other segments have each four raised black spots on each side, and the head is black, or has two black spots.

They feed (or feed at intervals) through the winter until May or June (statements are made that they live for two years), and, when full-fed, they spin a web, or form a case of wood-dust, in which they change to an ochreous brown, long, cylindrical chrysalis. This web is usually woven just inside the bark, near the entrance of the boring, so that when the time for development is come the chrysalis forces itself through the opening, and, by means of the fine prickles with which it is furnished along the back, it is held firmly in the web whilst the moth frees itself, and leaves the empty case projecting from the tree.

PREVENTION AND REMEDIES.—The caterpillars may be destroyed (like those of the Goat Moth) by drawing them out of their burrows with hooked wires, or by running a strong wire into the hole, and thus crushing the caterpillar within to death. If the wire, when withdrawn, is found to have wet whitish matter on it, such as would result from having crushed the larva, or again, if gnawed wood should have been passed out of the burrow up to the time of the operation and no more appear afterwards, it may be supposed the creature is killed; otherwise the operation should be repeated.

Syringing is also of service in getting rid of these caterpillars. For this purpose a gutta-percha tube with a sharp-pointed nozzle may be fitted to the syringe, and thus, by placing the point of the nozzle well into the hole, it may be filled with strong tobacco-water, soft-soap, or any mixture that may be preferred, such as will make the hole too unpleasant or poisonous for the grub to remain in, even if it is not killed by the application.

The fumes of sulphur blown into the holes are also very effective in destroying the caterpillars; and tobacco-smoke has been suggested for the same purpose.

This moth is preyed on by bats.

Common Vapourer Moth. *Orgyia antiqua*, Linn.

ORGYIA ANTIQUA.—Caterpillar (after Taschenberg); male moth; female moth, with abortive wings.

This infestation is not as well known as it ought to be on account of the destructive nature of the caterpillars, which appear, as circumstances may suit them, to prey on almost every kind of leafage, whether of Pear or Plum, or other kinds of fruit trees, Hawthorn or Sloe, Roses or other garden plants, or even Fir. The attack is very common, and to be found both in town and country, and in orchard houses, as well as out of doors.

From the circumstance of the female moth having only abortive wings, and laying her eggs on or near the webbed-together leaves or spun cocoon from which she came out, the attack (if not looked to) may be expected to increase yearly, but at the same time this circumstance may be turned to good account remedially.

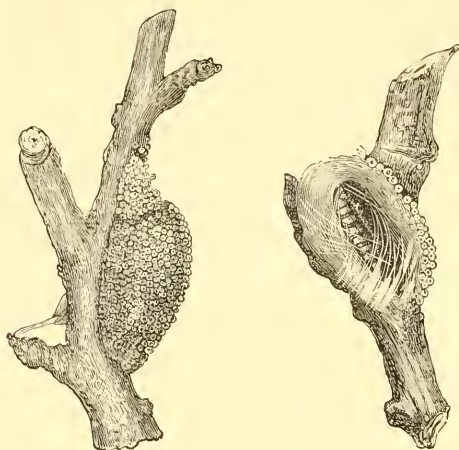
The male moths are of various shades of brown or chestnut, with the fore wings clouded with darker colour, and with a white, somewhat moon-shaped mark near the hinder angle. The females are grey, not quite half an inch in length, and have only abortive wings.

The life-history is that when the female moths come out from the chrysalis they creep on to the outside of the yellowish grey somewhat oval cocoon, and there pairing takes place. The female very soon begins depositing her eggs on the surface of the cocoon and in the immediate neighbourhood, and then dies.

It was recorded by Edward Newman ('British Moths,' p. 40) "that these eggs do not hatch all together, like those of moths in general, but come out a few at a time over a period of ten weeks, so that the caterpillar, chrysalis, and moths are all found together throughout the summer and autumn." The eggs of the late moths, which remain unhatched through the winter, have been seen (when under special observation) to hatch out their caterpillars about the 23rd of April.

These fine caterpillars, which vary in length from about an inch and a quarter to two inches when full grown, are dark

grey spotted with small red tubercles, and easily distinguishable by having four large tufts of yellowish or brownish hairs on the back, and also five pencils or bunches of long dark pin-headed hairs disposed—one on each side behind the head, pointing forwards; one on each side of the fifth segment; and one on the back of the penultimate segment, forming a kind of tail-like appendage (see figure, p. 135). By the above



Cocoons of *Orgyia antiqua*, respectively covered with eggs and showing chrysalis within.

characteristics the caterpillars are easily known from shortly after hatching.

When full-fed, which may be from May to August, they spin their cocoons (see figures above), mixed with hairs, on the twigs amongst the remains of the leaves on which they have been feeding, or on trunks of trees or palings, and in these the caterpillar changes to a dusky yellow chrysalis, from which the moth appears in summer in about a fortnight.

The excellent specimens shown above were sent me during November, 1890, from Croome Court, Severn Stoke, Worcestershire, by direction of the Earl of Coventry, and figured by his kind permission, and show the great number of eggs quite coating over the outside of the cocoon, and thus point out that the starting point of what would be much future mischief if neglected might be very easily got rid of where these egg-covered cocoons are in reach.

Specimens of the attack have not often been sent me, but I have had them in 1886 and again in 1890 from widely separated localities, as from Linton-on-Ouse; Porchester Terrace, London, where they did a deal of mischief; also

from Worcestershire ; and from the South of Ireland : and amongst fruit leafage attacked that of Pear and Victoria and Greengage Plum was especially mentioned.

PREVENTION AND REMEDIES.—Where infestation is known to be present the cocoons should be carefully searched for on all boughs in reach from the ground, or other observable localities, and these should be destroyed with the contents, or with the egg-deposit outside, as the case may be. Where the twigs are out of reach of common measures, the use of a pair of small sharp hawk's-bill nippers placed at the end of long handles would be desirable. I have myself found a form with light handles about five feet long very convenient.

Syringings with soft-soap mixtures, Paris-green, or other applications, such as are customarily used for leafage attacks, would be equally serviceable in the case of this infestation.

Pear Lyda ; Social Pear Sawfly.

Lyda pyri, Schrank ; *L. clypeata*, Klug ; *L. fasciata*, Curtis and Westwood ; *Pamphilius flaviventris*, Cameron.



LYDA PYRI.—Web-nest with caterpillars, after Taschenberg ; sawfly, female, magnified, and larva, full size, after Cameron.

The Pear Lyda, or Social or Web-spinning Pear Sawfly, as this species is variously named, is, so far as I am aware, not at all a common infestation in this country. Specimens of the attack have never been sent to me, excepting in the

year 1896; and with regard to prevalence of this insect, Mr. Cameron only says: "Probably common in gardens in England. I have not found it in Scotland." With regard to plants infested, he mentions that the "larva lives on Pear, Plum, and Cherry trees, also on the Whitethorn (*Mespilus*) and other rosaceous shrubs, feeding with many others under the shelter of a common web in June and July."*

On June 25th (1896) an excellent specimen of a web-nest of this species of *Lyda* with its tenants was sent me from Hextable, with the observation:—"As you see, it is on a Pear shoot. I found a batch on the same row of trees last year, and this season only one. Last season's batch were older, and of a bright orange colour; they would *not* feed in confinement, but lived about three months without appearing to feed, and then gradually shrank to very small dimensions. I have not found this insect on any other tree in the locality."—(C. B.)

The caterpillars sent proved, both in appearance and habits, to agree excellently with the description of the kind which is still perhaps most frequently known by its old name of *Lyda pyri*, or the Social Pear Sawfly. They were as yet (as noted by the sender) not full grown, being hardly half an inch long, the length attained at full growth being three-quarters or nearly an inch. The colour of the caterpillars reddish or reddish orange; they are very smooth and shining, and somewhat cylindrical. The head very shining black, with a pair of pointed antennæ, ringed black with a little white; rings apparently about seven,† but difficult to count with certainty. On the segment behind the head were some small black markings. The three pairs of claw-feet were of the orange colour of the body, and there were no ventral or sucker-feet; but on each side of the terminal segment was a pale antenna-like process (see figure of larva, p. 137), each about as long as the space across the top of the segment between the lowest joints of this pair of horn-like processes, which pointed slightly backwards. There was some variety in colour in the caterpillars, according to whether they had been lately feeding; in this case the devoured matter from the Pear leaves gave a greenish tint through the transparent skin. My specimens were obviously only about half-grown; but (as noted by Prof. Westwood‡) this kind does not, like many sawfly larvæ, change colour at different ages, but young and old are similarly coloured.

* See 'British Phytophagous Hymenoptera,' vol. iii. p. 97.

† Mr. Cameron says, "with long seven- to eight-jointed antennæ" ('British Phytophagous Hymenoptera,' vol. i. p. 53).

‡ See 'Gardeners' Chronicle' for 1851, No. for January 18th, p. 36.

The web-nest, in which the caterpillars lay, was three inches long, formed of threads spun from their mouths to the Pear leaves on which they were feeding, and when received (very likely a good deal injured in transit) was an irregular piece of webbing about three-quarters of an inch less or more in width. The earliest spun part, which was black with decay and dirt of various kinds, was deserted, and the caterpillars lay for the most part in two clusters, one of about twenty-two or more grubs, one of not so many. These were closely packed together in their web, but reached out from it to feed on the Pear leaves, which they greedily devoured, starting at the edge, and made great havoc with. In one instance they had eaten away about two-thirds of a leaf up to the mid-rib, leaving only part of some of the chief side veins.

The spinning powers of the caterpillars were very noticeable in endeavouring to reconstruct a shelter for themselves when a Pear leaf, which had partly covered over a large party of them, had been removed.

A little later, on July 21st in the same year, a friend and neighbour mentioned to me having observed a web-nest, estimated at about three inches across, on a Pear tree in her garden in Romelands, St. Albans. This contained about fifty shining, reddish orange, "worm-like" caterpillars, which were doing so much damage that the nest had been cut off and destroyed before I heard of it; but from the description (though without personal inspection) I do not think it could be other than one of the social collections of caterpillars of *Lyda pyri*.

The above are the only instances in which the attack has been brought under my own notice; but, looking at the bright shiny orange colour of the many caterpillars feeding together in a web several inches in diameter, and the devastation to the spun-up leafage, the infestation is one calculated to attract so much attention from the most unobservant, that it may be conjectured if often present it would be much more enquired about.

The main points of the life-history as given by German and English entomologists are as follows. The female sawfly lays (towards the end of May) from forty to sixty eggs, mostly on the under side of the Pear leaves. These eggs are longish in shape, yellow, and look as if smeared with grease, and are laid with great regularity in rows. The caterpillars, which hatch out in a few days, are at first of a whitish yellow colour, but become darker after the first moult, and begin immediately to spin a loose web, in the threads of which they climb to and fro. This web is enlarged, as requisite conse-

quently on the ragged and filthy condition which it acquires, or to enlarge the feeding-ground, and the caterpillars drag themselves about within it by holding on to the threads, and in four or five weeks attain their full growth.

They then let themselves down to the ground, and bury themselves as much (it is said) as four inches deep, or deeper still, in the earth, in a smoothed cavity, but without spinning a cocoon. Here they change to the perfect sawfly, which, according to recorded observations, may appear in the following spring, or in the spring next but one to date of going into the ground.

The figure at p. 137 shows the form of the fly and the neuration of the two pairs of wings. The fly is four to five lines in length of body, that is, from a third of an inch to rather more; the expanse of the wings somewhat under an inch; the colour chiefly black, but the abdomen tawny towards the extremity, with a triangular yellow mark in each segment; ventral segments banded with yellow. The base of the antennæ and also the legs yellow; the four hindmost of the thighs black at base. Wings hyaline, with a broad smoky band below the stigma. In the male the abdomen from the second segment is reddish yellow.*

PREVENTION AND REMEDIES.—The simplest and most effectual plan would be, as with other web-living infestations, wherever the webs are in reach, to cut them off and destroy them with their contents. But a little care must be taken in order to secure all the caterpillars, as on alarm, when nearly full grown, they may let themselves down by their threads, and so escape into the ground. This might easily be prevented by holding a pail below the nest with some sticky fluid in it, soft-soap wash for instance, which would effectually prevent stray caterpillars getting away; and indeed the best method of operation would be to cut the nest itself and its contents off into the pail of soft-soap wash, and thus make quite sure of none escaping.

Where the nests are out of reach, syringing soft-soap or soft-soap and paraffin wash at them, so as to sodden the web, would be good treatment, taking care, as before mentioned, to have something placed below to secure such caterpillars as might let themselves down.

Various observers have mentioned difficulty in rearing this sawfly in artificial circumstances, and perhaps the following

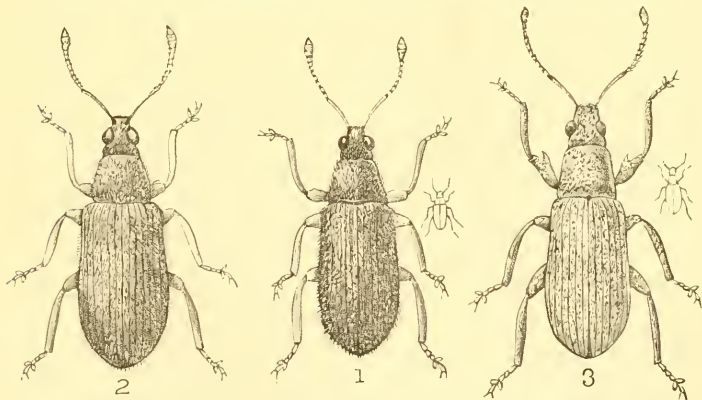
* For description of fly (*imago*) see 'British Phytophagous Hymenoptera,' by P. Cameron, vol. iii. p. 97; and for figure of fly, vol. ii. of same work, plate 6; and of larva and tail processes, plate 12 of same volume. These figures I beg to acknowledge with thanks as having been copied in my own figure, p. 137.

plan, which I have found answer well, though I have not tried it with this special infestation, might help those who wish to observe the life-history of this somewhat rare attack. I took a wire or pierced metal dish-cover, such as is used for preventing flies getting at meat in larders, and placed this on the ground over the larvæ and their food, or where the larvæ had buried themselves of which I wished to secure the perfect insects. Thus the grubs were left undisturbed in perfectly natural circumstances, and all that was necessary was to look frequently when the time of development drew near, lest, in case of Lepidoptera (*i. e.* butterflies or moths), the specimens should have had time to injure their plumage by beating on the metal cover. With specimens of this nature it is well to have a few twigs firmly set in the ground under the dish-cover for the newly-developed insects to crawl up and rest on whilst spreading their embryo wings to full size.

“Oblong Leaf Weevil”; “Downy Brown Leaf Weevil.”

Phyllobius oblongus, Linn.; *P. (Nemoicus) oblongus*, Stephens.

Green “Leaf” Weevil. *Phyllobius maculicornis*, Germ.



1 and 2, *PHYLLOBIUS OBLONGUS*; 3, *P. MACULICORNIS*: magnified and natural size.

The *Phyllobius* beetles taken together are described as “beetles feeding on the leaves and buds of trees and bushes, and of which many kinds are injurious to fruit trees.” But, though widely distributed, as much attention has not been given either to their life-history or to remedial measures as is desirable, and of the very few reports which I have received of their appearances, those given below may be of service as

showing the mischief that two of the species have been noticed as causing, and also the recurrence of the attack year by year when once established.

The Brown Leaf Weevil, figured at p. 141, is a common kind in this country, and sometimes very destructive, but is not generally so much noticed as the bright kinds of *Phyllobius* (the genus to which it belongs), of which one species, *P. maculicornis*, did damage over hundreds of acres in May, 1888, by devouring the leafage of various kinds of orchard trees, as of Apples, Plums, Cherries, Nuts, &c.

These Brown Leaf Weevils, *P. oblongus*, are of the shape figured magnified at p. 141, only about the sixth of an inch or a little more in length, and somewhat elongate or parallel-sided in shape. The head and thorax are usually black; the wing-cases variable in colour, pale dull red or brown, with the margins often black, or sometimes they may be entirely pale,—my own specimens, from Kent, have been with reddish wing-cases and black borders, also I have them with reddish brown, and yellower brown elytra, without borders; the head, thorax, and wing-cases are covered more or less with a rather long grey pubescence; wings present. This *grey down* distinguishes this species from the other *Phyllobius* weevils, which are for the most part beset with green *scales*. The antennæ (horns) are twelve-jointed and elbowed, the club elongate-ovate; the rostrum (or proboscis) short; eyes rather prominent; the legs yellowish or brown.

In the early summer of 1896 observations were sent me of great damage being done to orchard trees by these beetles at localities in the south-east and south-west of England. Specimens were sent on the 18th of May from Kent, with the observation that the Pear and Apple trees of the sender were so infested that at the time he had “the ground and trees full of them.” A little later on specimens were sent from another locality, with the observation:—“I may say that they have done me very great damage for years past. They appear about the first week in May, and eat the young buds of the Apple trees, &c.”

In continental records this Brown Leaf Weevil is stated to appear in some years “in astonishing numbers.” The devastation of the orchard trees begins with the appearance of the leafage, and first of all the buds are attacked, and where development takes place slowly a great part are destroyed. Grafted plants in nursery gardens are noted as especially liable to attack.

We do not appear (so far as I am aware) to have any English observations as to the life-history of this beetle in its early condition; but the following notes are given by

Kollar* from Canon Schmidberger's observations:—"It makes its appearance very early in spring, and is seen on the leaves when it has scarcely completed its development. It particularly prefers young trees, to which it is very destructive. No kind of fruit tree is secure from its voracity; the leaves of the Pear, Apple, Plum, and Apricot, and particularly those of the Peach, it considers delicious food. It generally selects only the best part of the leaf, and leaves the mid-rib and the petiole. . . . Pairing follows. . . . In June the female enters the earth to deposit her eggs there; and the grub that is produced from the egg feeds on the roots of different kinds of plants, passes the winter in the earth, and appears again transformed into a beetle in spring."†

PREVENTION AND REMEDIES.—Beating the beetles down in the early morning, or on dull days, is one way of lessening their numbers, bearing in mind that as they are *winged* the various precautions always advised should be taken against the disturbed beetles flying away and coming back to the trees.

Likewise washings or sprayings (for which see Index) of any insecticide poisonous or destructive to the beetles, and harmless to the leafage, could not fail to be beneficial.

To protect grafts, it is recommended to smear grafting-wax, or a mixture of clay, which might keep off the beetles. (I have no experience of this treatment myself.)

For winter treatment, anything done to the bark would presumably *be quite useless*, as, so far as appears, the larvæ and chrysalids are never to be found there, nor have we any notes of the beetles wintering in its crannies. But probably where the soil beneath the trees could be treated, we might do much there towards getting rid of the infestation. Skimming the surface and destroying it would do good if we could be sure we went down low enough to remove the grubs; but these being so very small, it would be difficult to detect their presence in the earth. But where the ground was bare, it would be well worth while to try the effect of as heavy a dressing as the owner thought safe of some chemical manure, as kainite, nitrate of soda, or any other application which

* See Kollar, 'Naturgesch. der Schadl. Insekten,' pp. 258-260; English translation, pp. 251, 252, in which this weevil is noted under various synonyms. In the English translation, revised by Prof. Westwood, that of *Nemoicus* is added, being the generic name under which Stephens separated this downy and *scaleless* *Phyllobius* from the scale-bearing species.

† It was considered by Nordlinger that the larvæ went through their changes not in the ground but in rolled-together leafage; this view, however, is stated by Kaltenbach not to have been confirmed; whilst subsequent observations have established the correctness of those of Canon Schmidberger, see 'Die Pflanzenfeinde,' p. 180.

(similarly) we know to be good for plant growth, and injurious to at least some kinds of insect life.

Green "Leaf" Weevil. *Phyllobius maculicornis*, Germ.

These little weevils are of a very similar size and shape (see figure, p. 141) to *P. oblongus*, mentioned above; but, instead of being of some shade of brown and covered with grey down, they are covered with bluish, or golden yellow, or greenish scales. The length of the beetles is about one-sixth of an inch, and the colour beneath the greenish scales is black; the wing-cases "with very short hairs scarcely projecting beyond scales"; horns mostly yellow red, with club black; legs black, with tip of shanks and feet brownish.

The following notes, sent me on the 16th May, 1888, by Mr. Arthur Rayfield, regarding the prevalence of this attack on the orchards of the late Mr. Faunce de Laune, at Sharsted Court, near Sittingbourne, Kent, show the persistence of the attack, the large area over which it extended, the variety of kinds of orchard and other trees infested, and also some amount of benefit by remedial treatment:—

"I herewith enclose some specimens of a green insect that I have observed on Mr. Faunce de Laune's fruit trees for three or four years past. They come in larger numbers each succeeding year, besides spreading over a larger area. I notice this spring that they first made their appearance about the 20th of this month. I have succeeded in catching a considerable quantity by shaking the trees (standards), and holding a tarred cloth beneath, on which they fall and stick, until some fresh tar is put on; but it is impossible to *get rid* of them in this way, as they swarm over several hundred acres, settling on fruit trees,—Cherries, Plums, Apples, and Nuts,—besides nearly all other kinds of trees and bushes, such as Thorns, Sloes, and even Firs. They appear to live on the leaves of what trees they alight on, but prefer those that have been newly planted. They take advantage of any shelter, and prefer the south side, in the sun, and out of the cold winds."

On June 1st, Mr. Rayfield wrote further that he had succeeded in catching great numbers of the leaf weevils "but there yet remain huge quantities. We are most successful in catching them in the morning and evening, when it is dull and not too much wind. They collect in larger numbers in sheltered places, but when disturbed by a sudden jar, while the sun is shining brightly, and in a warm temperature, some

take to wing, and consequently avoid the tarred cloth held beneath." A few days later—on June 4th—Mr. Rayfield reported that the beetles appeared to be diminishing in number, but, though he searched carefully, he could not make out where the eggs were laid, or the maggots lived.

This matter would be well worth investigating where attack is prevalent, and, by turning up sods in different places under some of the trees that were infested last year, there would be a good chance of finding the maggots. They might be expected to be whitish and legless, with a head furnished with jaws, and in general appearance, although much smaller, very like *Otiorhynchus* maggots (for reference, see Index).

For means of prevention and remedy, see p. 143.

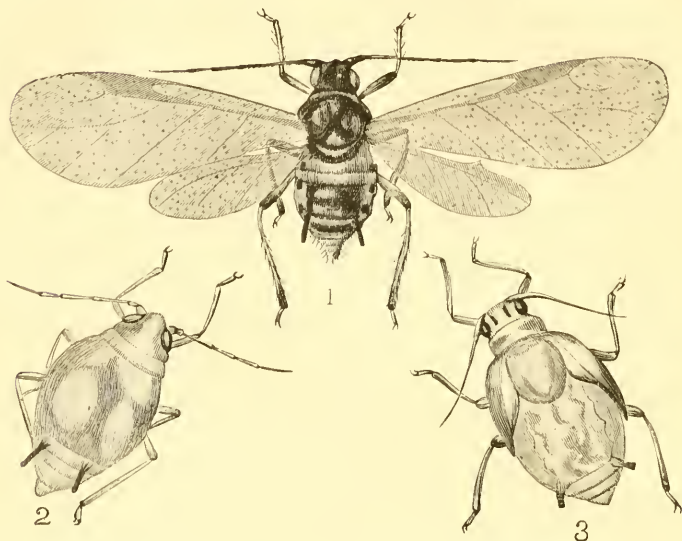
OBSERVATION.—Like Apple and Plum, the Pear is subject to a great number of insect attacks common to other orchard trees, besides those which are mentioned in the foregoing pages as more especially infestations of its own.

Amongst these may be mentioned, amongst Pear attacks, infestations of the Great Tortoiseshell Butterfly, Codlin Moth, Goat Moth, Lackey Moth, Mottled Umber and Winter Moths, the Wrinkled Bark Beetle (*Scolytus rugulosus*), the Apple-blossom Weevil, and a black weevil (*Otiorhynchus tenebricosus*, Herbst) which attacks leafage, the very common Cherry and Pear Sawfly and the Apple-blossom Sawfly, the Apple Aphis and the American Blight Aphis, and also the Mussel Scale.

As mentioned at p. 48 and in the Preface, it has been endeavoured, so far as was conveniently practicable, to give the infestations affecting several kinds of trees under the name of the tree, of attacks to which, observations were especially contributed; but in the alphabetical list of orchard trees, and fruit bushes, which precedes the Index at the end of this volume, the names of the infestations affecting each will be found enumerated.—E. A. O.

PLUM.

Plum Aphis or "Green Fly." *Aphis pruni*, Réaumur.*



APHIS PRUNI.—1, winged viviparous female; 2, wingless viviparous female; 3, pupa: all magnified. After G. B. Buckton, F.R.S.

The Plum Aphis or Green Fly (*Aphis pruni*, Réaumur) is to be found on Apple, Medlar, Peach, and Apricot, besides various kinds of Plum, and, as noted in 'British Aphides,' † "is exceedingly destructive. Multiplication takes place by millions, and the insects close up the pores of the leaves by their tenacious excretions and the mealy exudations from their bodies. By the constant irritation of their rostra [suckers] the leaves roll up, and under this cover from the weather both the winged and apterous forms live overspread by . . . mealy powder, which probably to them is a pro-

* Also of Fab., Kalt., Mosley, Walk., Koch, Pass. So much difficulty exists as to synonymic distinction of the above species of Plum Aphis, as also as to possible differences or variations, as well as synonyms of other species affecting the Plum, that I have given the above list of authorities and also moderately full descriptions of *A. pruni* in its different conditions abridged from the account given by Mr. G. B. Buckton in his 'British Aphides,' vol. ii. pp. 64-67, with figures from plate lvi. in the same volume, in order that both on his high authority and also as British description we may have a firm foundation for comparison with other Plum-infesting aphides.

† See 'British Aphides,' by G. B. Buckton, F.R.S., vol. ii. p. 64.

tection." They are to be found collected in numerous colonies on the under side of leaves of the young shoots, and are sometimes found in parties on the stems of the green fruit.

The winged viviparous female* (figure 1, p. 146) is one-fifth of an inch in expanse of the fore wings, of which the membrane is finely punctured, stigma greenish, veins brown. General colour apple green; head, horns, body between the wings, knees, and feet black. Abdomen green, with four lateral spots at each edge; dorsum with a squarish spot and two dark streaks below the cornicles (honey-tubes), which are dark olive or only tipped with black. Legs yellowish.

The wingless viviparous female is of various tints from green to olive brown, with three faint green stripes on the abdomen. The horns short, olive brown; the cornicles (honey-tubes) very small, brown. *The whole body, above and below, powdered with a cottony meal.*

The wingless oviparous† female "is greenish yellow, transparent, usually shows the mature eggs within" (see figure 2, p. 146). Of this it is noted that "the eggs in November are ready for laying, and freely pass from the body by a gentle compression" (G. B. B.).

The male is winged; the body of a dingy ochreous colour, with head, feet, honey-tubes, and various markings umber brown; and some males wholly black. Has been "taken rather numerously and in company with the oviparous female on the Apple tree towards the middle of November" (G. B. B.).

The pupa (for form see figure 3, p. 146) is shining green with shades of ochreous, two broad marks on the top of the head; wing-cases tipped with dark brown; honey-tubes green with black tips.

One very important point in the life-history of this species which distinguishes it from *Phorodon humuli*, the Hop Aphis or "Plum and Hop" Aphis, which also infests the Plum, is that this kind (*Aphis pruni*) is *not migratory*. It does not (like *P. humuli*) leave the Plum in early summer, and with the autumn season return in developed form from the Hop to hibernate. Observations in detail on this subject are given from p. 153 onwards.

PREVENTION AND REMEDIES.—Washes with a foundation of soft-soap are the most desirable, because they have the great advantage of sticking in some degree to the aphides. When these insects (as before noted) are covered with a kind of mealy powder, many of the washes used simply run off them

* *Viviparous*—producing living young.

† *Oviparous*—producing eggs.

at once; and unless the application *sticks to them*, so as to kill them, or is given so violently as to knock them from their position, the labour does little good.

For application to kill Green Fly on the Plum trees, the following mixture was reported to me by Mr. C. D. Wise (the Superintendent) as found serviceable in the Toddington Fruit Grounds, namely:—Quassia and soft-soap in the proportion of two ounces of each to each gallon of water, and Paris-green added in the proportion of one ounce to ten gallons of the decoction.

A decoction of quassia chips and soap, or soft-soap, has been found serviceable both for syringing infested trees and also, on a smaller scale, for dipping shoots in. One recipe for the mixture is—one ounce of quassia boiled for ten minutes in a quart of water, and a piece of soft-soap the size of a small hen's egg then added.

Mr. J. Masters, Secretary of the Evesham Fruit Conference Committee, wrote me as follows:—"The committee consider that the trees should be sprayed early, before the pest has developed. I had a row of trees last year, and the foliage was severely injured by the aphids. This year, before the trees had bloomed, we gave them a good syringing with soft-soap and a little paraffin oil, and this year we have no attack of the aphids in these trees; but other trees near, that did not suffer from the aphides last year, and where we did not dress the trees as above, we have found are severely affected this season."—(J. M.)

An addition of some amount of paraffin to soft-soap wash has been shown to be of use by the experiments of Mr. Ward at Stoke Edith in 1883 and 1884. The proportions used by him for large quantities were twelve pounds of soft-soap and half a gallon of paraffin to one hundred gallons of hot water, the mixture stirred well together and used when cool; the nearer boiling that the water is used the better the paraffin mixes. This wash is found to be very effective in killing aphides on Hop without injuring the plant or the burr, but it requires such great care in mixing, and also in use, *lest the mineral oil should separate from the soft-soap wash*, and also lest from state of weather or any other circumstance it should injure the leafage or burr, that I do not venture to *recommend* it as a Hop application.

The above observation of Mr. Masters as to dressing early for prevention of aphides corresponds with mention made by the U.S.A. Board of Agriculture ('Insect Life,' vol. iv. p. 343) on the importance of destroying the first generation of *P. humuli* "on Plum trees early in the spring with kerosine emulsion." This is very similar in its nature to the mixture

of soft-soap and paraffin; and at p. 87 of the same volume it is stated that the conclusion arrived at from experiments (for which authority is given) with kerosine emulsion for plant-lice is that this mixture is a perfect remedy against these insects if the application is thoroughly made.

This application is of such great value as an insecticide in the case of many kinds of leafage, also to destroy insects harbouring in bark, and for other preventive and remedial purposes, that I give the following recipes for preparing the emulsion, which would probably answer as well with paraffin oil substituted for the kerosine, which is not so much used with us as in the United States of America.*

Kerosine and Soap Mixture.—"To make this I use one-fourth of a pound of hard soap, preferably whale-oil soap, and one quart of water. This is heated till the soap is dissolved, when one pint of kerosine oil is added, and the whole agitated till a permanent mixture or emulsion is formed. The agitation is easily secured by use of a force-pump pumping the liquid with force back into the vessel holding it. I then add water, so that there shall be kerosine in the proportion of one to fifteen."—(Prof. A. J. Cook, in Bulletin 26 of the Agricultural College, Michigan, U.S.A.)

I give the above recipe first, because, being noted as a satisfactory application for the Apple Aphis, it may be presumed the proportion of kerosine would not be enough to injure ordinary bark; but all experimenters should bear in mind that the strength and amount of mineral oil used must be well considered, and the same strength may not be safe on all parts of young trees, or on all conditions of leafage.

Another recipe is for "kerosine emulsion" of the ordinary strength for general application, *viz.* kerosine or refined coal oil, 1 pint; common laundry soap, $\frac{1}{2}$ oz.; rain-water, $\frac{1}{2}$ pint. The soap was boiled in the water till all was dissolved, then the boiling soapsuds were poured into a watering-pot containing the kerosine, and churned with a garden-syringe until the emulsion was complete. This generally takes about five minutes, but sometimes longer. When this emulsion is made, it can be bottled up for future use. When using it, either as a wash for sponging trees or for spraying, it must be diluted with nine times the quantity of water. Should the oil in the emulsion after a time separate, it is well to warm it, and by violently shaking the bottle it will again become fit for use. In diluting the emulsion use warm water. See p. 14 of 'Report of Entomologist and Botanist, Department of Agriculture, Canada,' 1887.

* For other mixtures of soft-soap and paraffin, &c., see Index.

The following recipe is one of the Department of Agriculture of the United States of America. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of “emulsion,” as it is termed, make thirty gallons of wash. Warning is given that care must be taken with *each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.*

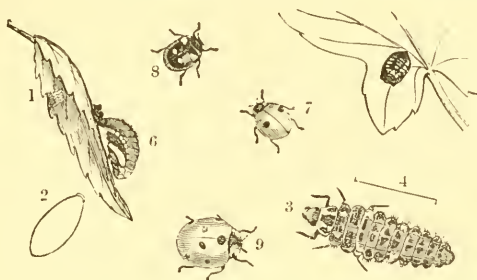
This point of testing the strength that can be borne by different kinds of leafage and by leafage in different conditions is exceedingly important, and so also is the matter of the soft-soap and the mineral oil being so *thoroughly incorporated* that they will not separate. If they do, the mineral oil will be sure to cause much injury to the leafage on which it may fall without being diluted by the soft-soap mixture.

For those who do not care to be at the great trouble of mixing the emulsion, it would save time and expense to try the use instead of a mixture sold by Messrs. Morris, Little & Son, Doncaster, under the name of “antipest.” This is very similar in ingredients to the “kerosine emulsion,” and being sold ready mixed and only needing further diluting saves much trouble; it is sold at a very cheap rate, and I have used it for a good many years with success as an insecticide in my own garden.

Where there is plentiful water supply at hand, and also means of throwing it with force, I have known much benefit come from sending even this, with no additions, strongly at the stems and branches; fairly “swilling” the tree down; and where infested shoots with the leaves loaded with aphides can be cut off without damage to the tree, enormous masses of the pests may thus be removed and destroyed instead of going on breeding and spreading infestation around.

Amongst natural means of protection we have some help from the aphid-eating birds; but our chief assistance is from the *Coccinellidæ*, the beetles well known as “Ladybirds,” which feed (especially in the larval stage) voraciously on the aphides.

The figure below shows the appearance of the slaty-grey six-legged grubs (magnified, with line giving length when full-grown). These grubs are prettily marked, with scarlet



COCCINELLIDÆ.—1-4, egg, magnified; larva and chrysalis, magnified, and with natural length; 7, *Coccinella bipunctata*; 8, *C. dispar*; 9, *C. septempunctata*.

and yellow, and when full-fed, which is in about a fortnight or three weeks, they hang themselves up by the tail, and turn to a shiny black pupa or chrysalis, spotted down the back with orange, from which the beetle (known as the “Lady-bird”) comes out in about another fortnight or three weeks. The figures give the common red Ladybird, distinguishable by its seven black spots, and also two smaller kinds.

These should be by all means protected, and especially when they appear in the vast swarms in which they frequently follow on a special outbreak of aphides, and in which, to our great injury, they are liable to be swept up and destroyed, as in the instance of their great appearance in 1869.

Hop Aphis; Hop and Plum Aphis.

Phorodon humuli, Schrank, and var. *maluheb*, Fonsc.

The genus *Phorodon*, to which *Phorodon humuli*, commonly known as the Hop Aphis, belongs, is especially distinguished by the first joint of the antennæ being bluntly toothed or gibbous, and by also possessing frontal tubercles having a strong tooth developed on the inner side, as conveyed to some degree in the figure (p. 152) of the wingless viviparous female.

The winged viviparous female of *P. humuli* is of a pale green colour, lighter underneath; head and band on prothorax dark brown, some other markings on the thorax black; abdomen with one or more cross stripes and four spots on each side

also black; antennæ green at their bases, tips brown. Legs with thighs and tips to the shanks brown. The frontal tubercles less developed in this than in the wingless female. Expanse of wings rather more than a quarter of an inch.



APHIS HUMULI.—Winged and wingless viviparous females, magnified.*

The wingless viviparous female is small, oval, pale green, with one to three green stripes along the back. Body sometimes shining, and sufficiently transparent to allow the tracheæ to appear like silver threads. Frontal tubercles dentate. First joint of the antennæ gibbous and porrected.

The winged male is smaller than the winged female. Colour pale green excepting some parts of the thorax which are olive. Antennæ and wings long. Head and thorax much developed, and frontal tubercles prominent.

The above notes are abridged from Buckton's 'British Aphides,' vol. i., elsewhere frequently referred to.

The wingless oviparous female, which only appears in autumn, is noted by Prof. Riley in his English observations † as being white at first, and becoming yellowish orange and olivaceous with maturity, the head and the members darkening.

The larva (or louse, as it is commonly called in its earliest stage) is very pale; later on, in the pupa state, the head and fore part of the body are broad and squarish and the colour green.

For many years the migration of "Hop Aphis" from Plum to Hop in the spring or early summer and return of the descendants of these migrants back again from Hop to Plum in the autumn has been considered to be established as the case, both on the authority of many Hop growers and also by observations of scientific observers qualified to distinguish one kind of aphid from another.

* The above figures are acknowledged, with thanks, as reduced copies of figures 1 and 4, plate xxx., vol. i., of 'Monograph of British Aphides,' by G. B. Buckton, F.R.S.

† See 'Gardeners' Chronicle' (London) for October 22nd, 1887.

So long ago as the year 1854 it was recorded by Prof. C. L. Koch* in his work on aphides that he found Hop Aphis on Plum and Sloe, and he mentioned the great numbers in which this species (*Phorodon humuli*) was to be found on these trees or bushes in the latter part of May. He described the species in its various conditions (that is, as female, young, &c.) from what he saw on Plum and Sloe, and after giving details of these he added:—"In the month of June this kind of aphis quits the leaves of the Sloe" (or wild Plum), "and then betakes itself to the wild and cultivated Hop, where it settles on the under side of the leaves, sometimes in immense numbers."—(C. L. K.)

From my own examination of specimens and collection of observations of Hop Aphis attack during the latter part of March to about the end of August in the year 1884 (and also in subsequent years), and from comparison of published views of entomologists who have paid especial attention to this kind of aphis attack in England, Germany, and the United States of America, there appears to me to be no reason to doubt that a great part at least of the attack of "Green Fly" which usually appears on Hops towards the end of May comes on the wing from Plum, Damson, Sloe, or other plants of the Plum kind, and may be certainly recognized as of the genus *Phorodon* (Passerini) and of the species *humuli* (Schrank), that is to say, what is commonly known as the Hop Aphis, and is described by Buckton as *Phorodon humuli*, Schrank, and *Phorodon humuli* var. *malaheb*, Fonsc.†

It was not, however, until the long and careful observations which were made by Prof. C. V. Riley, the Entomologist of the Board of Agriculture of the United States of America, were carried out by him in America and in England (in this country in the autumn of 1887) that we became possessed of the knowledge of the whole life-history of this Hop Aphis (*P. humuli*) from its hybernation on the Plum in egg state, and spring migration on the wing, in sequence up to the details of its autumn existence at the time of its migration back from the Hop to the Plum, and the laying of the eggs to start the next year's brood.

Details will be found in the papers by Prof. Riley referred

* 'Die Pflanzenläuse (Aphiden),' von C. L. Koch, pp. 114–116.

† For some considerations published during 1897 as to standing of "*malaheb*" as a variety of "*humuli*" or as a distinct species, see following notes under the heading of *Myzus malaheb*. In my own observations I have considered *malaheb* to be only a *variety*, as stated by Buckton to be his opinion ('British Aphides,' vol. i. p. 168), together with his considerations and collation of opinion on this subject of various writers; and also description, pp. 168–171, of *P. humuli* var. *malaheb* with notes of the *first antennal joint being gibbous* in the females described (and as figured, p. 152), as well as of existence of the frontal tubercle. In spelling of the word *malaheb*, I follow the different writers.—E. A. O.

to below,* from which I extract some of the leading points; and also, as during Prof. Riley's stay in England I was favoured by communication with him regarding autumn migration of which details had not previously been recorded, I give some extracts from letters from him to myself on this subject.

Some few of the leading points of Prof. Riley's observations may be shortly stated as follows. *Phorodon humuli* hibernates in the winter egg state; the little glossy black ovoid eggs are fastened to the twigs (generally the previous year's growth) of different varieties and species of *Prunus*, both wild and cultivated, and are especially found in the more or less protected crevices around the buds. The egg is difficult to detect because it is covered with particles which resemble the bark in colour and appearance. They are usually not more than four or five in number.

From these eggs the aphides hatch which are the mothers of the coming infestation; the colour pale green, and "the tubercles *between the horns* hardly observable." Three generations are produced upon the Plum, the third of which becomes winged, and instinctively abandons the Plum and migrates to *Humulus*, that is, to the Hop plant.

A number of generations are produced upon the Hop (all without occurrence of the male sex) until in autumn winged females are produced, known as the return migrants, which fly instinctively to the Plum. Here they settle, and in the course of a few days (according to weather) each produces some three or four young. "These are destined never to become winged, and are true sexual females." Somewhat later, on the Hop, the true winged male, *the only male of the whole series*, is developed, and these males also congregate upon the Plum, on the leaves of which, toward the end of the season, they may be found pairing with the wingless females, which stock the twigs with the winter eggs. Such briefly is the life-history.

In regard to dates in this country of the above described autumn migration. In the year 1887 Prof. Riley wrote to me, on September 15th, from Maidstone in Kent:—"As I anticipated, I have found *Phorodon humuli* just migrating from Hop to Prune, and first wingless generation on Prune, but no eggs yet." On September 24th, also, writing from

* Paper by Prof. C. V. Riley read before Section D of the British Association for the Advancement of Science, Manchester, Sept. 3rd, 1887. "Notes on the Hop Plant Louse," paper by Prof. C. V. Riley read before the Society for the Promotion of Agricultural Science, Cleveland, Ohio, U.S.A., August 21st, 1888. See also 'Insect Life,' United States Department of Agriculture, vol. i. pp. 70-74; and "The Hop Plant Louse," pp. 133-137 of same volume. Likewise 'Eleventh Annual Report on Injurious Insects,' by myself, pp. 84-86.—E. A. O.

the neighbourhood of Maidstone, Prof. Riley noted, "*Phorodon* swarming on Plum trees here." On October 1st Prof. Riley wrote me that he had now brought the *Phorodon* investigations to a successful close, and completed his observations of the whole life cycle:—"Last week pairing was everywhere going on, and on Saturday I noticed the first eggs. The Plum trees are now being rapidly stocked. The male is winged and the female wingless, as I had surmised." Prof. Riley further informed me that the aphid eggs which he had seen on the Plum shoots became black, and this agrees with the information sent me for several years preceding 1887 whilst investigations were going on, that they had noticed black eggs, from which they had not any doubt that the aphid which they hatched was Hop Aphid.

Prof. Riley observed that although the winged emigrants from the Hop preferred the Damson, yet they also fed and bred on all other varieties of Plum which he had the opportunity of examining, including the Bullace, the Victoria, the Black Diamond, the Yellow, the Greengage, and the Orleans.

These observations relatively to migration, for full details of which the reader is referred to works cited p. 154, coming as they do from such a high authority as the late Prof. Riley, and also as being the result of his long-continued personal investigations, give thorough confirmation to the belief previously much held as to Hop infestation coming on the wing from Plum; but still I do not myself think that in this country, though much of the attack comes in this way, that it is *wholly* so originated, and especially with regard to the very earliest appearances.

I think this because we have found aphides (that is, wingless females and lice) on Hop as early as the end of March and the beginning of April, long before the attack coming on the wing made its appearance.

Just to give a few instances:—In 1884 Mr. C. Whitehead, writing to me from Barming, Maidstone, on the 29th of March, mentioned, "I have found the enclosed Hop shoot, with the larvæ *in situ*, in my Hop ground this morning. There was a wingless female, which had evidently deposited viviparously the larvæ enclosed. . . . I dress late, and so I have plenty of shoots which will soon be cut off, and upon these I found the lice I sent to you. I went out in the afternoon and found lice upon many of the hills, . . . where there were small lice, in most cases a wingless viviparous active female was not far off. I found them chiefly in a part sheltered from cold winds, and where hatching or awakening from hybernation would be early. I should say I found a hundred at least in ten minutes."

On the 31st of March (that is, two days later) I had information from another locality in Kent, of some "lice" being found on "Grape" Hops. Early in April, Mr. Whitehead further wrote me that he had found more "lice" on Hop shoots, and that two farmers had just called and brought more, and on the 12th of April Dr. T. A. Chapman, writing from Hereford, reported that after careful search in the Hop-yards where the bine was two feet high, he could find *no trace of "fly,"* but on the following day he found a bine with seven or eight aphides on it. These were wingless and nearly full-sized.

Also in the Stoke Edith experiments, made in 1884, it was found that in the case of the Hop-hills which were dressed with applications to keep the aphides from coming up from around the Hop plant, the bines on these hills (more than twelve hundred in number) were free from attack until the fly came at the end of May, *although the rest of the Hop-yard was infested.*

We do not know the reason of this at present, but it may at least be conjectured that it is owing to some amount of hybernation of the aphid in female or egg state in the Hop-hill.

PREVENTION AND REMEDY.—Measures for lessening presence of this attack on Plum are similar to those for remedy of *Aphis pruni* mentioned at p. 147, in its summer form as a broadscale attack in Hop fields, the treatment is not wholly applicable to orchard and garden use.

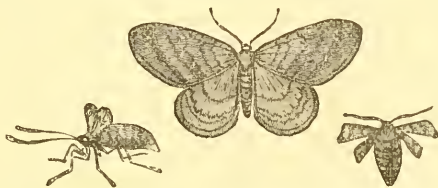
OBSERVATION.—*Myzus mahaleb*, Fonsc.—In Bulletin No. 7, New Series, of the United States Department of Agriculture, Division of Entomology, pp. 52–59, is an able paper by Prof. Theodore Pergande, with life-history and carefully detailed descriptions of this migratory species of Plum plant-louse as observed by the writer, and considered, so far as he has been able to ascertain from his personal investigations made near Washington, U.S.A., in 1886 and 1887, to be identical with the species known under the various synonyms of *Aphis mahaleb*, Koch, *Myzus mahaleb*, Passerini, *Phorodon humuli* var. *malaheb*, Buckton, and others unnecessary to specify here.

The great point (from an economic point of view) of Prof. Pergande's observation is the circumstance that, "whereas *Phorodon humuli* subsists as far as is known exclusively on different varieties of Plum and Hop," migrating from the Plum in spring to the Hop, and return migrants in autumn leaving the Hop and supplying the Plum with a new infesta-

tion, in the case of the species observed by Prof. Pergande the spring migration, although occurring from Plum to a great variety of plants of most dissimilar nature, *is never found on the Hop*; the return migrants, however, reappearing on Plum in the autumn, as in the case of *P. humuli*.

From such views as I am able to form after studying Prof. Pergande's careful descriptions, it seems to me that the characteristics of the frontal development of *P. humuli* var. *malaheb*, as observed in England, distinguish it from *Myzus mahaleb*, Fonsc., now under consideration, as well as its remarkable difference in nature of plants selected as its summer hosts. But the matter has been gone into with such minute and skilled observation by Prof. Pergande that I offer my own views under submission, and only as it may prove to be a point worth investigation for practical purposes in our own Plum and orchard grounds.—E. A. O.

Winter Moth; Evesham Moth. *Cheimatobia brumata*, Linn.



CHEIMATOBIA BRUMATA.—Male and wingless females.

NOTE.—In the following pages the treatment for prevention and remedy relatively to injury from caterpillars of Winter Moth are entered on in long detail, as these are equally applicable as remedial measures against caterpillars of the other moths noticed on subsequent pages of which the females are wingless; and also the treatment by spraying with kerosine emulsion or Paris-green is serviceable against leafage caterpillars generally. The notes are given under the heading of "Plum," as it was on this orchard tree that the practical work, even to the extent of treating 80,000 trees, was carried on at Toddington.—E. A. O.

The Winter Moth is perhaps the most injurious of all our orchard insects. In some years, when favoured by drought and heat, the mischief is widespread also in woodland, and especially on Oak leafage; but amongst orchard trees the caterpillars prey on the leaves and buds of Plum, Apple, Pear, Cherry, and Nut; also during several years information was

sent me from the Toddington Fruit Grounds of the attack occurring on Currant bushes growing beneath infested trees; and in the year 1895 specimens of the Winter Moth caterpillar were sent me from near Kidderminster as "a sample of the pest that we have been troubled with for the last two or three years; they devour both Gooseberries and Plum alike.

The "Winter Moth" is not quite accurately described by either of its English names, for though it may be found in great numbers still going up the trees towards the end of November, yet precautions against it (if they are to be of real service) should be taken fully five weeks earlier; and some amount of appearance of the moths may occur about the end of March. Also, although it is a notable pest in the neighbourhood of Evesham, it is by no means confined to that district.

The male moths are from an inch to an inch and a quarter in the spread of their fore wings, which are silky in texture, and greyish or ochrey brown in colour, marked with several indistinct wavy darker transverse lines or bands; the hind wings pale, and of a greyish white.

The female moths are dusky grey, not absolutely wingless, but *furnished merely with abortive wings too small to be of any service in flying*. The fore pairs are marked with two cross streaks in each, the hinder pair with an indistinct streak. The abdomen is very large in proportion to the fore body, so as, with the long legs, to give the insect very much the appearance of a spider.

About the middle of October (one of the earliest observations of capture sent to me was on the 17th of the month) the female Winter Moths come out from the chrysalis cases beneath the trees, where they developed from the caterpillars that went down in summer, and creep up the stems to lay their eggs. The moths are most active from sunset, or rather before it, till late in the evening, and the males are stated to appear a few days before the females. If this is so, it would be a convenient guide as to time being come for sticky banding, an item of information much needed; for at present observations taken at places at no great distance from each other give a range of somewhere about a month in difference in date of first appearance of the moths, and this with no details to account for the variation.

The female moth creeps up the tree and lays her eggs on buds or twigs, or in crevices of the bark, and from an enormous collection of trimmings from *Pear trees* (the result of three men's work during three hours, sent me a little after the 10th of March, 1890, from Glewstone Court, near Ross), the moths had particularly selected the little furrow between

the wood and the bark where shoots had been cut back for egg-deposit; at the truncated end of these cut-back twigs, or small boughs, the Winter Moths had laid their eggs in such numbers that the little specks could be seen with the naked eye, arranged so as to form a ring more or less scattered just inside the bark, which had healed since pruning, and so made an outside line of protection to the eggs. This will be found excellently figured in a paper on "The Caterpillar Scourge" in the 'Journal of Horticulture' for June 5th, 1890 (Fleet Street, E.C.).

The eggs when laid are stated to be greenish white, but to become orange and subsequently brown before hatching; my own observations began in the second week in March, when the eggs were changing from their reddish colour to the tint that *immediately precedes* hatching.

At about the above date, that is, the 11th of March, 1890, Mr. J. Garrood, of Ledbury, had kindly furnished me with a small bundle of Apple twigs, which had been placed in a box in the autumn preceding, with a number of Winter Moths, male and female; the eggs deposited on the spurs sent me being the eggs of these Winter Moths.

These eggs were bluntly oval, or cylindrical, rounded at each end, about the thirty-second of an inch in length, and the width about two-thirds of the length. The skin was pitted over the surface; with the help of a moderate magnifier it had the appearance of being shagreened; under a one-inch power the markings showed as circular depressions so regularly placed as almost to give a honeycomb-like appearance. Some of the eggs were still of the pale reddish tint of which the above appeared to be when sent me; a few were of green tint, this apparently from the colour of the caterpillar within, now near development, showing through the filmy egg-skin; and the many empty egg-shells were now (when seen through a magnifier) mere iridescent films, almost glassy in brightness. To the naked eye they gave the appearance of the parts of the twig on which they were placed being beset with little patches of greyish or bluish mould, or of the down natural on some kinds of Apple twigs.

On the 26th of March many of the eggs had hatched, and at this date the caterpillars (from the eggs sent me by Mr. Garrood on the 11th) were perfectly active, moving about characteristically in loops, or placing themselves erect on their sucker-feet. The colour was dingy green or grey; heads black, thus agreeing specially in this point with the observation of Dr. E. L. Taschenberg, that after the first moult the caterpillars have black heads (as well as a black spot on the nape of the neck). Thus, with the guidance to identification

given by Mr. Garrood's specimens, clearly known to be eggs laid in confinement by isolated specimens of Winter Moths, we make the great step onwards of being able to distinguish whether there is infestation of this kind present on the boughs, and to prepare accordingly.

With the guidance given by these specimens, I examined portions of the very large collection of egg-infested cuttings from Pears above alluded to, kindly placed in my hands by Mr. C. Lee Campbell, and found the eggs to be precisely similar in every respect. The eye was similarly attracted by the little bright or whitish mould-like spots, and (similarly) I found empty egg-shells, and greenish eggs and some still reddish. The eggs had similar inequalities on the surface, and the little looper caterpillars were similar in appearance, and, though hardly the sixteenth of an inch in length, were when disturbed already able to spin a thread to attach themselves by.

A few days later—on the 31st of March—I found many of this collection of eggs were changed from the reddish colour to a variable iridescent tint, grey or bluish, or occasionally greenish, according as the light fell upon them.

One of these eggs I punctured, and watched the caterpillar emerge; and this larva, and another that I watched in natural process of emerging, appeared to me indistinguishable from young Winter Moth caterpillars; and at this date I found many little caterpillars, apparently almost all little Winter Moth grubs, on the paper on which I threw out the twigs, these varying in tint, as is frequently the case with this variable kind. Some were of different shades of greyish or greenish grey, and one little larva was almost black.

This kind of caterpillar is described by Edw. Newman, in his 'British Moths,' as being very variable, sometimes green, sometimes smoky brown, sometimes approaching to blackish.

They not only are variable in colour one from another, but they also change in appearance after each moult. The following is just a short general note of these changes, taken from Dr. Taschenberg's more detailed description.*

When hatched they are greyish, afterwards of a yellowish green, faintly striped with white along the back, and with dark head and mark on the neck. Afterwards the dark colour is thrown off, the green is of a clearer tint, and the white stripes plainer, and after the last moult the caterpillars are of a yellower green, with a light brown shining head. A stripe

* For good accounts of the life-history of the Winter Moth see 'Praktische Insektenkunde,' by Dr. Taschenberg; likewise the account in 'British Moths,' by Edw. Newman, and likewise that given in Kollar's 'Insects Injurious to Gardeners, Foresters, &c.'

of darker colour down the back is probably (or, at least, in part) from the food showing through the skin. When full-grown they are about an inch long.

Like others of the caterpillars specially known as "loopers," this species has, instead of four pairs of "*sucker-feet*" below the body, only *one pair besides the pair at the end of the tail*; so that in walking it cannot progress forward continuously, but has to bring the sucker-feet and tail-suckers forward to where it is held firm by the claw-feet (see figure of Mottled Umber Moth); thus it forms an upright "loop," whence the name of "looper."

Whilst still small and weak the caterpillars attack the most tender part of the young growths, but gradually (in bad cases) sweep everything eatable—buds, flowers, leaves, or growing fruit—before them, until the ravaged tree, with the remains of brown spun-up knots of leaves on it, looks as if it had been scorched by fire. They prey on many kinds of trees, besides the orchard trees where they are especially injurious to us; and when full-fed, which may be from the middle to the end of May and sometimes as late as June, they leave the trees (as far as is recorded, by letting themselves down by their threads) and go down into the ground, where they turn to chrysalids near the surface, from which most of the moths come up in autumn.

Some of the moths, however, remain in the chrysalis state during winter, and do not come out until the following spring; and the brood from these spring moths coming later than the others accounts for the succession of appearance of young caterpillars sometimes observed.

PREVENTION AND REMEDIES.—The points to be considered lie under three main heads:—1st, how to keep the wingless moths from gaining access to the trees for egg-laying; 2ndly, if eggs are laid, how to destroy them or lessen their numbers before hatching-time; 3rdly, if caterpillars appear, how best to get rid of them without injury to the leafage of the infested trees.

Various kinds of apparatus have been recommended, both in Germany and America,—some of wood, some of bands of tin applied in various ways,—in order to keep the wingless moths from gaining access to the upper part of the trees; but there are various objections to the use of these (at least so it appears to me), partly from the care that has to be taken to prevent harbourage of eggs, &c., beneath them, and partly from the expense. Therefore though I believe that attention continues to be drawn to their application from time to time in this country, I do not myself especially *recommend* them,

and this more particularly as I am not aware of having had reports sent me of satisfactory trial with us of the metal or wood apparatus. At pp. 12, 13, under the head of Codlin Moth, a recipe is given for a less cumbrous method of banding which has been found serviceable in South Australia, but with these arrangements the care which is requisite lest they should prove rather a centre of infestation than a barrier to its advance is against their adoption.

In an exhaustive Report by the late Prof. Riley, referred to below,* almost every point appears to be entered on which may be of service for prevention of attack similar to that of our Winter Moth, and various sticky mixtures are mentioned and methods of applying them, but the principle is the same as that of our own treatment.

But what is at hand, cheap, and has proved to be effective, is best; and, so far as appears at present, none of the extra-British methods of preventing the wingless moths gaining access to the trees are to be preferred before the methods of application of the plan of "grease-banding," or "sticky-banding," which have been worked forward by the attention of some of our own leading fruit-growers, so as to be *easy and cheap of application, effective* for purpose needed, and also (which is a most important point), so managed in the laying on as *not to injure the bark*.

Two of the most important points to be considered in "sticky-banding" trees are:—(1st) What material is best to use in order not to hurt the trees, or (if it is of a hurtful nature) how best to prevent it soaking into the bark. (2ndly) What time or times of year the "smear" should be applied.

With regard to the material to be used, the following notes show that cart-grease answers the purpose of *catching the moths* thoroughly well, but also that it is requisite for orchard growers to ascertain what the application furnished to them is composed of, lest the so-called cart-grease should be mixed with tarry or other matter deleterious to the condition of the bark.

So early in our special preventive operations as Dec. 1st, 1888, I was favoured by Mr. Charles D. Wise (Deputy Manager of the Fruit-grounds at Toddington, Winchcomb) with the following note regarding commencement of operations. This report shows the large scale of the operations, and their success in preventing the ascent of the moths, and likewise warns against the use of tar. Mr. Wise wrote:—"I think you will be interested to hear that we have caught

* See the chapter on "Canker-worms," pp. 157-197 of the Third Report of the United States Entomological Commission published by the Department of Agriculture, Washington, U.S.A., 1883.

millions of the wingless moth this season. As many as five hundred have been counted caught in the band of grease on a single tree. As we have something like 100,000 trees, it has been a great business putting the bands on and keeping them sticky. We have tried many different mixtures, but on the whole I have found cart-grease by itself, put on *thick*, answers best; it is cheapest, and I think does no harm to the tree. . . . Where tar has been used, I have found the tree alive up to the place where the band was put on, but above the band dead." And in another letter the late Capt. Corbett (then Manager) further wrote on the same subject:—"Please note I have discarded tar, for I have found instances where, even when mixed with grease, it has, on drying, formed a tight band round the bark, and destroyed the tree."

The following valuable observation on the subject of nature of grease or material used for banding, and necessity of protecting live bark from being choked by smears, was also kindly placed in my hands by Mr. J. Masters, of Evesham, Hon. Secretary of the Fruit Insect Conference Experimental Committee:—"It is most important to be guarded in buying grease. Some dealers offer you a cheap article, and it is a vile compound of injurious mixtures. Get a good article, free from tar, if you pay more money for it, is my advice.

"I should recommend in all cases where there are young trees, and where the bark of the tree is smooth and tender, that *grease-proof paper should be first banded round the tree and the grease put on the paper*. But on old trees where the bark is rough, I do not think that grease (*good*) would be injurious. Trees should be daubed not later than the middle of October. A good daub should be used, and looked after that it is kept moist and adhesive, otherwise moths will cross over it."—(J. M.)

These points need very careful attention, for though it is very possible that on old trees (where the thickness of the old bark protects the vital layer of *young bark and wood* forming beneath almost as effectually as if a cradle of pieces of cork was fastened round the tree) there may be no damage caused by tarring, this is very different to making use of it on young trees, where, as it has been very well described, it fairly "*waterproofs*" the sodden tissues; and I believe myself that tar should *not* be used on young bark, and in any case should be used with care and caution.

With regard to cart-grease itself, so far as a regular form can be given, it appears to be usually compounded of tallow, palm oil and soft-soap, or, what comes to the same thing, tallow, palm oil, and water, and caustic soda. The following notes of the ingredients of some of the mixtures or prepara-

tions commonly made use of or sold under the names of "waggon-axle" or "railway grease" may probably be of service in showing the ingredients of the ordinary compositions, and also that some of the additions or special makes, for suitable special machine use, are by no means what can be recommended for spreading at haphazard on living vegetable tissues.*

Of two kinds of railway or waggon grease mentioned in the work below quoted, one consists essentially of a mixture of a more or less perfectly-formed soap, water, carbonate of soda, and neutral fat, whilst the other is a soap of lime and rosin oil, with or without water. Frazer's axle grease consists of rosin oil of various numbers, saponified with a solution of sal-soda in water and softened lime; and these two rosin recipes are apparently very similar to a composition used with success at Toddington.

Some other mixtures are merely of greasy or soapy compositions; one is of tallow and palm oil melted together and mixed with soda; two others are of palm oil and tallow for the foundation, mixed respectively with sperm oil and caustic soda, or with rape-seed oil and soda; another, the "Austrian railway grease," is of tallow, olive oil and "old grease."

So far there would be nothing deleterious to bark beyond what injury may occur from grease gradually soaking into the tissues, but a preparation of "axle grease," composed of black oil or petroleum residue, animal grease, powdered rosin added to soda-lye, and salt, would be highly undesirable to smear on unprotected bark.

I have had notes of Davidson's composition being very serviceable for smearing.

Guarding the bark. — Where bark is thick and dead on the outside, as on old Apple trees, or where dressing is chosen of some kind which will not sodden into the tree in the heat of the sun, it *may* (as above mentioned) do no harm if smeared on to the unprotected bark. But where year by year the smear must be kept on for weeks in autumn and winter, and very possibly have to be applied again towards the end of March, to stop the ascent of the spring brood of the Winter Moths, and also the wingless females of the March Moth, some protection is needed. If this is not given the grease will soak into the cells and stop the passage of the sap, and the tree will die.

At present the simplest and cheapest, and also most successful plan that I have had notes of is that which was largely used at one time, and very probably still is, at Toddington.

* See pp. 376-379 of paper on "Lubricants" in 'Workshop Recipes,' by C. W. Warneford Lock, published by E. & T. N. Spon, Charing Cross, London.

The material employed is the kind of tough paper which is made use of by grocers for wrapping up butter, lard, and the like, and is known as "grease-proof" paper. This is applied by a band as many inches wide as is thought fit (the wider the better) being passed round the stem of the tree. The band should be cut long enough for the ends to overlap well, and these are fastened by paste, and the whole is made secure by a piece of bast-mat, or anything that will not cut the paper, being tied round the paper near each edge. This work can be rapidly and well done by women. On the paper bands the grease or application may be spread in any way preferred, but the best way is considered to be to lay it on with a thin flat bit of wood, and plentifully, both as to width of band and thickness of layer. In this way (when I saw the managers of the Toddington Fruit-grounds in the autumn of 1889), 80,000 *Plum trees* and about 40,000 more of other kinds were being treated.

A slightly different method of binding was tried, also with good success, by Mr. E. R. Cheesman, of Bough Bridge, Edenbridge, Kent, of which he gave me the following note:—

"Now the course I have followed is this: I have first placed bands of impervious paper (such as is used by grocers for butter and other greasy substances) of about seven inches in width round the trees, a foot from the ground, first removing loose and rough bark so that the bands should lie quite close; on this I have placed a similar width of glazed lining-calico, and tied tightly with strong string at an inch from both top and bottom of band, so that wind and rain cannot move it in the least. I have then used a mixture of cart-grease and soft-soap, mixed to the required consistency with train oil, and laid on to the bands with ordinary paint-brushes. This was done by October 16th, and they have been served in the same way every week since, so as to keep them always sticky. . . . We have caught some thousands of both the males and females (which seem to keep together) of the *Cheimatobia*, a few of a much larger sort of moth, also wingless or nearly so [probably Mottled Umber—ED.], but these latter are not in any quantity here. I may add that in very few cases have any of the moths got as far up as the middle of the band, and I am fairly satisfied that we have caught all that had attempted to ascend. This mode is a little trouble and expense, *but the latter does not exceed twopence per tree*, even on full-grown trees, which most of mine are, many being very large ones; and this is a very trifling outlay, if a crop can be saved by this means."—(E. R. C.)

It is of great importance to begin the grease-banding in good time.

Captain Corbett reported to me from Toddington Fruit-grounds, from the experience of some of the foremen who had given special attention to date of banding, that "all trees greased before Oct. 17th were nearly free from caterpillar. Those not greased until Oct. 17th were infested with caterpillar." As a help to know when the moths might be expected to appear, Captain Corbett further noted:—"I would just add that another foreman kept some chrysalids of the Winter Moth in a box last autumn, and on the first moth coming out he put the band of grease round his trees. His trees are for the most part thickly laden with Plums."

Taking various reports sent me, it appeared that presence of wingless moths was observed at different dates from Oct. 11th to Nov. 19th, at which time the Winter Moths were still going up the trees in large numbers; therefore during this period, and as long as examination shows that moths are still being captured, care should be taken that all the bands are soft and sticky.

Stakes and tree-guards need attention. — Where young trees are fastened to stakes, something of course must be done to stop traffic up these poles or stakes and thence to the trees; and where bundles of rough sticks are tied round the stems to prevent these being gnawed by animals, these guards will also probably be a most fertile source of caterpillar attack at hatching time in spring, unless well looked to. For stopping traffic up the guards or stakes tar would do very well, but it would be difficult to apply any treatment that would not be very troublesome to the bundles of sticks. In such cases, banding above the sticks or the attachment of the guards is the safest course.

But though by means of the grease-banding vast numbers of moths are stopped in their upward traffic wherever the plan is properly carried out, still there are difficulties which have to be watched for and remedied, such as passage of stray moths over the sticky bands when they are becoming dry, or over the dead bodies of the moths which have been "stuck" in numbers on the bands; also the difficulty arising from many of the moths stopped in their upward passage laying their eggs on the tree below the band, and the caterpillars from these, when they hatch out in the spring, making their way upwards.

Soft-soap and mineral-oil washes and emulsions. — On application to Mr. J. Fletcher, Entomologist of the Dominion of Canada (requesting his advice as one of the very best authorities as to prevention of caterpillar attack), regarding the surest way of destroying eggs left as above noted, he wrote as follows:—"For washing the trunk, to destroy all eggs

which may have been laid during the winter, a kerosine emulsion may be used. This should be done in the end of March."—(J. F.)*

The following recipe is one of the Department of Agriculture of the United States of America. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of "emulsion," as it is termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.

The above mentioned methods of treatment to prevent autumn and winter ascent of the wingless moths for purposes of egg-laying on the twigs, and also to destroy eggs from which caterpillars might presently hatch and crawl up the trees, have been found to answer very well *for these purposes*; but there are further difficulties which require other and also broadscale treatment to meet them at a paying rate.

One very important point is the circumstance that there may be late appearance of the Winter Moth, of which development has been delayed until spring, and it is very unlikely that watching (and testing) for its passage up the trees and a new course of grease-banding would then be adopted.

Another point is the *transportation of the wingless female Winter Moths to the trees by the males whilst pairing*. This point was not sufficiently observed until within the last two or three years to be taken into practical consideration, but it bears to a very important extent on presence of attack. But though placing a light at night under an open shed of which the lower part of the roof has been tarred has been found to answer to some degree, this can hardly be considered satisfactory broadscale treatment.

As a special preventive measure, where the plan can be carried out, *late pruning, and burning all the pruned-off shoots*,

* Various recipes for soap and kerosine or paraffin oil mixtures will be found at pp. 148–150, under the heading of Plum Aphid. The above is repeated here to save trouble in reference.

is a very good practice, because the Winter Moth is considered to lay her eggs by preference towards the ends of the shoots; therefore where these are cut off and burnt, when the chief laying season is over, which might be put about the middle of December, much infestation is got rid of.

I had a very good note on this subject, on February 6th, 1889, from Mr. C. Lee Campbell, of Glewstone Court, Ross. In this, after some observations on attempted measures for checking infestation, he suggested a more effectual remedy—consisting in cutting off the ends of the branches on which the eggs have been deposited, and burning them:—"I have found that an enormous proportion of the eggs are deposited at the end of every branch pruned in the autumn, as much as fifty eggs being found on one branch. At a moderate calculation, my men have thus destroyed some 6,000,000 eggs on 5000 to 6000 Pyramid fruit trees within the past months, in addition to a very large number caught through greasing the stems."—(C. L. C.)

But now passing on to remedies which can be applied to the attack when the caterpillars of this and other kinds are ravaging on the trees.

What we need is a "WHOLESALE TREATMENT" which may be brought to bear at one time on all the kinds of caterpillars alike, whether loopers, or web-nest making caterpillars, "Small Ermines," or "Tortrix," or Lackey caterpillars, or any other of the many kinds of pests which are alike in their habits so far as destroying the leafage of our orchard trees is concerned, and to destroy these surely without injuring the foliage.

For many years trials were made, in many isolated cases, of various kinds of treatment which it was hoped *might* be of use in lessening this yearly amount of loss; but as these experiments were seldom carefully recorded as to details or results, they were of little public benefit.

Therefore, about the end of February in the year 1890, at a conference of fruit growers held at Evesham, a Committee of Experiment was formed, of gentlemen personally interested in the subject (and also qualified practically, as well as scientifically, to superintend experiments in orchard treatment, and report results), in order to try the effect of any kind of sprays, washes, or other applications which they might judge likely to be effective in destroying the caterpillars on orchard trees without injuring the leafage; and to meet at various different centres from time to time, so that the whole Committee could judge of results of various treatments, and consultation and detailed reports of the method of treatment respectively take place, or be given by the members.

Paris-green was one of the applications especially selected for experiment, as having been known for many years to act trustworthily as an insecticide in the United States and Canada, and also because, from the Government Reports of both countries, we were able to learn all requisite details as to precise methods of application ; and further we were most kindly aided in our experiments by advice from Mr. J. Fletcher, the Dominion Entomologist of Canada.

At the meetings of the Committee the several experiences of the members were given, showing clearly that, even under careful experiment, just the same uncertainty occurred with regard to reliable effects of *almost* all the applications, as has appeared long to be the case. Alum, hellebore, ammoniacal liquor, and many other applications were tried, and sometimes found useful ; sometimes, as in the case of alum, found occasionally useful, but also, and on very careful trial elsewhere, of not the slightest service ; and later on, when the caterpillar was more advanced, the alum was found to be of no service at all.

Paris-green used as a liquid application—that is, mixed in an excessively small quantity with very much water, and sprayed as a mist on the trees—answered for the most part well ; and I give the following directions for use, and also cautions required (the chemical being of a poisonous nature), from the Government publications of Canada and of the United States, together with our own experiences.*

DIRECTIONS FOR USE OF PARIS-GREEN.—*For liquid application.*—The amount recommended in Canada for spraying for Codlin Moth or young “looper” caterpillar is “not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water (4 gallons, E. A. O.), to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves.”

“*For general use on mature foliage.*— $\frac{1}{2}$ lb. of Paris-green, 50 gallons of water. First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom.” (See also 18th and 19th lines from top of p. 171.—E. A. O.)

The amount found serviceable by the Evesham Fruit Committee coincided almost exactly with the weaker mixture mentioned above. The Committee decided that they could

* Special details will be found in various of my own Annual Reports ; also a condensed account in my ‘Manual,’ second edition ; and plain directions for use in my leaflet on Paris-green, for gratuitous distribution.—E. A. O.

recommend "Paris-green paste in the proportion of 1 oz. to 8 or 10 gallons of water for Plums; and 1 oz. to 20 gallons of water for Apples." Apple leafage was found to be more tender than that of Plums. Pear leafage should be treated like that of Apple.

For Currants the strength found safe was the same as for Plums—1 oz. of "green" to 10 gallons of water; but as the foliage grew stronger, 1 oz. to 8 gallons of water was found not too strong. Neither of these strengths of mixture damaged the leafage, but they killed the caterpillar.

These proportions should not be exceeded. In some instances greater strength has been used without bad effects on the leafage; but this was certainly attributable, in one case, to heavy rain following the over-application, and probably, if details were procurable, non-injury from over-strength could be traced to casual coincidence in other cases also.

Capt. Corbett, the Superintendent of the Toddington Fruit-grounds, writing to me on the 3rd of July, and mentioning his satisfaction with the results of spraying, also noted, "The proportions I fixed upon after the first trials, *viz.* 1 oz. to 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples, must not be exceeded."

To the above, Mr. Masters, Secretary of the Experimental Committee, added a further note, with the following information and useful hint regarding mixture of flour with the green:—

"When the foliage of trees is young and tender, I do not think it safe to apply the Paris-green stronger than in the proportion of 1 oz. to 10 gallons of water. But when the foliage is matured, and the caterpillar is full grown, a solution of 1 oz. of Paris-green to 6 gallons of water may be safely used; for every case it would be well to use about 2 lb. of fine wheat flour to every pound of Paris-green; it thickens the solution, and prevents the particles of Paris-green from settling at the bottom of the vessel, and, when it is sprayed, helps to secrete the preparation on the foliage."

One point of difficulty which occurred in the experiments and needs care in regular work is the risk of hot bright sunshine occurring after spraying and causing mischief to the leafage, this especially where the right strength has been exceeded, or the spray not rightly delivered at the leafage, but so that it remained in excessive quantity.*

* In Bulletin No. 36 of the Agricultural Experiment Station of Missouri, 1896, on remedial measures to destroy two kinds of leaf caterpillars, it is mentioned that those of the small moth *Teras minuta* may be destroyed by spraying with the following mixture: Paris-green, 1 lb.; fresh lime, 3 lb.; water, 150 gallons; and it is especially observed:—"Never omit the fresh lime; always use as much fresh lime by weight as Paris-green. This will lessen the chances of burning the leaves by repeated sprayings."—J. M. Stedman, Entomologist; October, 1898.

In application of Paris-green sprayings, it must always be borne in mind that, whatever kind of engine or spraying machine is used, the mixture must be kept an even strength throughout, and no sediment allowed to form at the bottom, or damage to leafage is sure to happen.

On these points Mr. Fletcher, the Dominion Entomologist of Canada, wrote to me as follows, and also enforcing care as to over-application :—

“Paris-green.—You are quite safe in recommending this ; but insist upon these two things, viz. 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated ; and as the barrel is frequently re-filled the residue will keep accumulating, until it will be too strong as the mixture reaches the bottom. 2ndly. The other point is to insist upon the mixture not being made too strong ; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1 lb. to 120 gallons.”—(J. F.)

With regard to method of application of the spray.—This should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

It should on no account whatever be thrown so as to “swill” or “souise” the trees, and run off the leaves in drops or streams ; this is bad practice in every way. It uses a great deal more of the chemical than is needed ; the leaves get little but pure water at their highest part, and much too strong application where the fluid has settled at the tips ; and also a drip is caused on to the ground beneath, which may render the grass temporarily poisonous.

Also, spraying should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it.

In mixing and in the use of Paris-green as a fluid dressing, or spray, one of the first points to be borne in mind is that this chemical does not dissolve in water. It is simply held in suspension ; the following is a good recipe for mixing so as to ensure the powder and water being thoroughly mixed to start

with:—"Two bucketfuls of water are first poured into the can, then three tablespoonfuls of good green, well mixed with another half-bucketful of water and strained through a funnel-shaped strainer, . . . the use of which prevents the larger particles of the green from getting into the can and clogging up the sprinkler."

The exact method of mixing, however, is quite immaterial—only remembering that the powder should be thoroughly diffused through the water, not allowed to be in lumps; and also the methods are best which allow of the operator mixing *without handling or inhaling the powder*.

For the above reasons, and also for convenience in mixing, the "paste" form before mentioned is preferable to the powder.

Mixture of flour with Paris-green.—The addition of flour to the mixture of Paris-green has been found to answer here, and has been strongly advised in the United States, because of the greater adhesiveness thus given, and also because the difference of colour helps to show the amount that has been distributed on the leaves. "Two or three pounds of flour" is an amount named as useful to add to a mixture of Paris-green in 40 gallons of water, but the precise quantity does not appear to be very important.

Where the plan is adopted of mixing flour with the Paris-green, the following method has been advised:—To take a large galvanised iron funnel of capacity suited to the work; for filling a 40-gallon barrel a funnel of 13-quart capacity is noted. This funnel has inside it a kind of strainer (described as a "cross-septum") formed of fine wire gauze, such as is used for sieves, and this also has vertical sides and a rim to keep it from rocking on the barrel. The quantity wished of cheap flour is placed in the funnel, and washed through the sieve-like wire gauze by water poured in; thus the flour is finely divided and diffused in the water, and the Paris-green subsequently added and washed down in the same way by addition of the rest of the water until the barrel is full.

With regard to the nature of Paris-green.—"Paris-green" is an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing, and should not be applied to fruit, or to vegetables that are used for food; but, as will be seen in the directions for use, the quantity advised for orchard use in the Canadian Government Report, to check looper-attack on leafage, is very small; and our English experience of eight years has shown that it can be as safely used here (with proper care) as it has now been used for regular farm and orchard work for many years, over an area of many thousands of miles, in the Continent of America.

On application to Messrs. Blundell & Spence, of Hull, as being well-known manufacturers and great exporters of Paris-green, Mr. J. Dixon (Manager) wrote me on December 31st, 1889 :—" Emerald-green, Paris-green, Schweinfurth-green, are different names for the same thing. The first name is English, and is the one used in most of our Colonies, India, and China; the second is the American term; the third only used in Germany, and by German traders.

" Emerald- or Paris-green is a double salt of arsenite and acetate of copper—in other words, an aceto-arsenite of copper. You may take the U. S. A. analysis of Paris-green as correct.

" The pure article (which is that used as an insecticide) is a true crystal, and varies in colour from a deep to a pale green, according to the size of the crystals."

Mr. Dixon also favoured me with the following percentage analysis of pure Emerald-green :—

" Percentage composition of Emerald-green :—

	Per cent.
" Copper	32·11
Arsenic	28·56
Oxygen	32·48
Hydrogen	0·76
Carbon	6·09

Total . . . 100·00."

Cautions to be observed in the use of Paris-green.—The bags should be labelled POISON, and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful colour.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder through mouth or nose whilst measuring or mixing it.*

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders, or, what is better still, have it in the form mentioned as "Paris-green paste," that is, the powder just damped so that it cannot fly about. If swallowed in any quantity by being drawn in with the breath it would certainly be harmful. An instance is on record in which a man employed to weigh out and wrap 5 cwt. in 1 lb. papers lost his life therefrom. But with the most ordinary care the application may be mixed and used, as well as hellebore and other poisons often applied in orchard and other farming work, with perfect safety.

The following notes of some of the results of the series of experiments undertaken officially by Dr. William M'Murtrie, as Chemist of the United States Department of Agriculture, in order to ascertain the effects of Paris-green on soil and the plants grown therein, are of importance relatively to occasional unfounded objections still urged against the use of Paris-green:—

"1. An aggregate of 906·4 pounds of Paris-green per acre must be applied before any injurious effects on plant-growth are appreciable. (The ordinary application to a Potato field is from a pound to two pounds per acre.)

"2. Arsenic cannot be absorbed and assimilated by the plant in the economy of growth. All of the plants grown in the arsenical soil tried by Marsh's test failed to indicate the presence of arsenic.

"3. Potatoes subjected to applications of Paris-green failed to give evidence of the presence of arsenic."*

The above is useful as showing the safety with which Paris-green may be used relatively to any fear of it being absorbed by the roots into the tissues of plants grown in soil where this arsenite may be present. On the *surface* of fruit or leafage used for food, as, for instance, if it is used as a dressing for Gooseberry caterpillar or on Cabbage leaves, it would *obviously be poisonous* if partaken of. Therefore no article of food dressed with Paris-green should be partaken of until either by lapse of time, growth of the fruit, or careful washing, the poison has been quite certainly removed.

The cost of the Paris-green is very little. The firm with whom I have chiefly corresponded on the subject inform me that as wholesale manufacturers they could furnish quantities of 1 cwt. and over at the rate of 10d. per lb. Retail dealers would probably not furnish the pure article under 1s. 3d. per lb.

London-purple.—This preparation is an arsenite of lime and has long been used as an insecticide in America, and for some years has been applied also in this country in the same manner as the above-mentioned arsenite of copper, commonly known as Paris-green; but it is stated that, owing to its lightness, a far smaller quantity by weight of London-purple will treat a given number of trees than would be required in the case of Paris-green.

Very few observations have been sent to me from orchard-growers regarding the use of this insecticide, but some good notes on the subject, and as to its serviceableness for destruction of leafage caterpillars, have been communicated by

* "Paris-green as an Insecticide," pp. 25–34, of Dr. Lintner's 'First Annual Report as State Entomologist of New York State, U.S.A.'

Mr. F. Nixon, of Great Eversden, near Cambridge, who is well qualified to form an opinion on the subject; these will be found at pp. 107, 108, preceding.

It is to be remembered that, like Paris-green, it is a Poison, and must be used with care accordingly.

In the case of either of these arsenites, the strength of the mixture should be tested by application on a small scale, before use generally, so as to avoid risk of broadscale damage. But the following observations by Prof. John B. Smith, from his entomological work* referred to below, may be of service:—

“Both the insecticides just mentioned can be made entirely harmless to foliage by adding weight for weight of caustic lime when mixing; that is to say, in preparing the poison for use take one pound of Paris-green or London-purple and one pound of quicklime; add water enough to slake the lime, and mix thoroughly while hot, so as to incorporate lime and poison completely. This will fix with the lime every particle of the soluble arsenic contained in the mixture, and it can then be diluted with water and applied at almost any reasonable strength, without much danger of injury to even the most tender foliage.”—(J. B. S.)

An arsenite of lead, known as “gypsine,” has much more recently come into use in America with much the same range of usefulness as the *two other poisons* mentioned above; but as yet I am not aware of it having been adopted for service here.

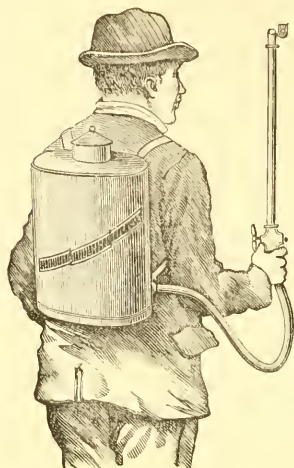
Kerosine emulsion.—For those who object to the use of poisons, the application of “kerosine emulsion” ranks next after that of Paris-green as an insecticide for broadscale use on leafage of orchard trees to make a general clearing of caterpillars.

In the course of the preceding pages recipes have been given for preparation of this “emulsion,” and of various other soft-soap and mineral oil mixtures very similar in composition, for reference to which see Index; but it should always be remembered that unless the operators are thoroughly well informed of their work, that it is only prudent to experiment before beginning broadscale application as to the effects on leafage of the strength that is being employed.

In regard to spraying machines, the call for them has been followed by such a plentiful supply, that to particularize one kind rather than another might be deemed undesirable; but at least it may be admissible to point out the serviceableness of “the knapsack sprayer,” which is a can or reservoir that

* ‘Economic Entomology,’ by John B. Smith, Sc.D., Entomologist to the New Jersey Ag. Coll. Exp. Station, &c., p. 435. Philadelphia, U.S.A.: J. B. Lippincott Co. 1896.

may be carried on a man's shoulder, and by means of a hose and nozzle throws a fine spray to the height of fourteen or fifteen feet. This form is particularly adapted for fruit-bush



or orchard treatment where there is no room for the passage of hand- or horse-machines. Of these there is all requisite choice up to the large horse-machines adapted to spray, under ordinary circumstances of wind, three thousand trees a day.

In the foregoing pages I have endeavoured to put as shortly as possible the main points of treatment by which attack of caterpillars of the wingless moths may be greatly *prevented*; and also the sweeping *remedial* measures by which not only these, but the caterpillars of all our common kinds of injurious orchard moths, even when established on the leafage, may be cleared by the use of sprayings of soft-soap wash of various kinds of composition, and still more certainly by Paris-green.

The use of this insecticide has now been so fully established that it takes its place amongst our regular methods of treatment without special consideration; but those who wish to study in detail much of scientific interest regarding the composition and method of application, also something of the difficulties which had to be overcome in its first introduction, will find the information in the following papers:—"Paris-green as an Insecticide," 'First Annual Report on Injurious and other Insects of the State of New York,' 1882, by Dr. J. A. Lintner, State Entomologist, pp. 25-34: Albany, U. S. A.; "Notes on Paris-green," pp. 8-16, in 'Seventh Annual Report of Noxious and other Insects of the State of Missouri,' 1875, by Prof. C. V. Riley, late Entomologist of Department of Agriculture, U. S. A.; "Paris-green," 'Fourth Report of United

States Entomological Commission, U.S. Department of Agriculture,' 1885, pp. 143-148; and other reports quoted from in preceding paper.

March Moth. *Anisopteryx æscularia*, Schiff.



ANISOPTERYX ÆSCULARIA.—Winged male, wingless female, and band of eggs.

The March Moth is a common kind, and, as described by its name, is to be found early in the year; and, in German observations, the caterpillars have been recorded as often noticeably injurious to Plum, together with those of the Winter Moth (*Cheimatobia brumata*). With us, however, it is rarely reported (so far as I am aware) as an orchard pest, and I have no notes of it being sent me on any orchard tree excepting Plum; other trees which it is recorded as infesting are Elm, Oak, and Lime, also Hawthorn and the Sloe.

In 1890 the wingless female moths were observed at Glewstone Court, near Ross, Herefordshire, as beginning to lay eggs about the middle of March. The specimen sent me on March 15th I found (on the 18th) had laid eggs, using the hairs from the tuft at the end of the tail (see figure), as is the custom of this moth, to cover them with. In the previous year it was observed at the end of March laying its bands of down-embedded eggs on Plum at the Dimsdale Fruit Farm, Westerham, Kent, and specimens were forwarded me of the wingless females, together with the Plum twigs on which they were then laying, on March 29th.

The moths were about three-eighths of an inch long, brown or fawn-colour above, shading to grey below, with darker head and eyes, and dark pencil of hair at the end of the tail, and might be generally described as thickly pear-shaped (the pencil of hairs at the end of the tail answering to a broad, short fruit-stalk—see figure). The hairs were long, the six legs very long, and the moths, though sometimes quite quiet, were able at pleasure to walk very rapidly; one that I timed as to speed walked the length of six inches in twenty-five seconds. The wings were to all appearance *totally absent*, not merely abortive as in the case of the Winter Moth, and the downy coating of the moths very smooth and silky.

The wings of the male moth are ample, the fore wings rather of a dingy brown colour, and marked with various transverse darker or lighter bands or lines, as figured at p. 177; the hinder wings paler, with a transverse zigzag line.

The Plum twigs which were sent me were quite small (none of them as much as a quarter of an inch across), and the bands of eggs which were then laid (or being laid) varied from about a quarter to half an inch in breadth at the widest part, but did not always quite encircle the stem. They were deposited with beautiful regularity, and showed to the naked eye as if laid in almost precisely parallel rows along the twig, and were embedded in down supplied by the parent moth from the pencil at the end of her tail. In the *largest* band I counted twenty-nine rows, and as each of these rows (as nearly as I could count or estimate) was composed of upwards of eighteen of the bright shining eggs, the whole number in this ring would be well over five hundred; but the size is so variable that in many cases the number in each ring or patch would be much fewer.

In the observations of eggs and caterpillars of this species, given by Mr. G. T. Porritt,* he mentions that of eggs which he received on April 3rd, 1872, some hatched on the journey, and the remainder hatched immediately. The larvæ from these grew rapidly on hawthorn, and by the middle of May were going down, and by the end all the caterpillars had gone down. From these, at date of writing (March 11th, 1873), the moths were emerging, nineteen males preceding the appearance of the first female.

The full-grown caterpillar is described by Mr. Porritt as "Length about an inch, slender, cylindrical, and of uniform width throughout; head globular, slightly broader than the second segment; skin soft and smooth. Ground colour bright green, strongly tinged with yellow; head uniformly green; a dark green line very narrowly edged with grey forms the dorsal stripe; the subdorsal and spiracular lines are greyish white, and between the subdorsal and spiracular lines is a very fine pale grey line. The segmental divisions are yellow, and the spiracles black. Ventral surface uniformly bright green, with the segmental divisions yellow."—(G. T. P.)

These caterpillars, like those of the Winter Moth and Mottled Umber Moths, are "loopers," that is, walk in an upright loop-form consequently on the characteristic number of sucker-feet (beneath the body) being only one pair instead of four pairs, as described at p. 161, and figured p. 179. But in observations by the Rev. J. J. Hellins, in paper above referred

* 'Larvæ of British Butterflies and Moths.' Vol. vii. Geometræ, part i. p. 157. Ray Society.

to, he remarks that in the case of this larva, when it is "almost half-grown, it plainly shows some rudiments of legs on the ninth segment," and, further on, that there "are on the ninth segment a pair of feet perfectly formed, but useless for walking, being about one-sixteenth of the size of the pair on the tenth segment."—(J. J. H.) The observation of the existence of a pair of abortive sucker-feet on the segment preceding that which carries the pair characteristic of "loopers" is not of practical importance, but is of interest scientifically.

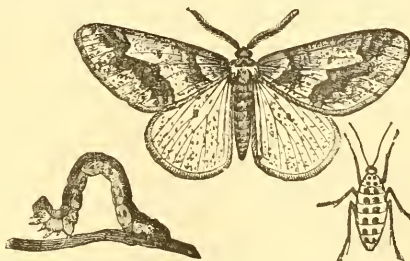
The cocoon formed by the caterpillar is stated to be of long oval shape, and of tough texture, being lined with close woven yellowish silk, and covered with fine earth.

PREVENTION AND REMEDIES.—In some cases, when the ground beneath infested trees is bare, a disturbance of the surface during winter, or before developing time in spring, might do good, of course taking care not to go deep enough to hurt the roots. In this way the cocoons would be turned out of the previously arranged shelters to alternate cold and wet, which is an excellent method of lessening amount of insect vermin.

Another means of prevention, in the case of trees where the end twigs are *in sight and in reach*, is looking towards the end of March or in April to see whether the ends of these twigs are infested by the bands of eggs, and, if so, having these cut off and destroyed.

For general measures of prevention and remedy, and especially of *remedy* by applications of soft-soap and other washes, see notes given at pp 161–176, under the heading of Winter Moth.

Mottled Umber Moth. *Hybernia defoliaria*, Linn.



HYBERNIA DEFOLIARIA.—Male and wingless female; caterpillar, after Taschenberg.

The Mottled Umber Moth is a common kind and widely

distributed, and a very general feeder. The list of trees of which the caterpillars infest the leafage comprises Cherry, Plum, Apple, and Nut, amongst orchard trees; and amongst forest trees, Oaks, Limes, Elms, Beech, Service, Birch, and others; besides Whitethorn and Sloe;* also they have been especially noted as feeding at times on unripe Cherries, gnawing away one side of the fruit.

The infestation may almost rank with that of the Winter Moth in its destructiveness, and (similarly) it is the male moth only which is winged. This is of the size and appearance figured, that is, about twice the size of the Winter Moth; the fore wings are usually of a pale brown or reddish yellow, with dark transverse bands, and "between them is a dark spot in the middle of the wing. The hind wings are rather paler, and have a brown spot near the middle; all the wings are more or less sprinkled with brown dots." Sometimes, however, the wings are merely of a reddish brown freckled over with minute dots.

The female moth is of a wainscot-brown colour, with *two very conspicuous dark spots* on the back of each segment. The wings are so abortive as to be almost invisible.

The caterpillar of the Mottled Umber Moth is a "looper"† (see figure at heading), like that of the Winter Moth, previously noticed, but is somewhat larger, and may be easily distinguished by its peculiar colouring.

It is of a clear or reddish brown above; "this area is bounded on each side by a very distinct but narrow waved black stripe, and is also adorned with grey markings"; "below the boundary the body is bright yellow; the spiracles are white, and the region surrounding each spiracle brown; the belly is greenish yellow; legs and claspers pale."‡

The caterpillars are often sent me amongst other orchard pests, and are very easily recognizable by the bright yellow stripe along each side, and by their gay and peculiar colouring. The female moths also are easily distinguished by the *brown spots on their backs* from the females of the Winter and March Moths.

The life-history of the infestation may be generally described as follows:—When full-fed, which may be, according to circumstances, *from towards the latter part of May even until the beginning of July*, the caterpillars leave the trees, and go down to the ground, where they turn to chrysalids at, or a

* Die Pflanzenfeinde, von J. H. Kaltenbach, pp. 163, 189.

† For characteristics of "looper" caterpillars, see p. 161.

‡ The above descriptions of the appearance of the moths and caterpillar are almost entirely taken from Edward Newman's 'British Moths,' p. 105.

little below, the surface. From these, in common rule (though some may remain unchanged till spring), the moths come up in autumn. The development begins in October, and may last till December, and even occur later irregularly till spring, which causes great difficulty in certainty of prevention by sticky-banding.

The female moths creep up the trees and lay their eggs on buds or twigs, or in crevices of the bark, or in the little furrow between the extremity of the cut-back twigs and the bark healing over the edge. From these eggs the little caterpillars come out towards the end of March, or, speaking more generally, when their food is ready for them, and as they grow (in years of bad attack), devour indiscriminately all they can reach, whether buds, or flowers, or leaves, or growing fruit, until, as noticed in cases of bad attack, the ravaged tree, with the remains of the destroyed spun-up leafage, looks as if it had been scorched by fire; and, if the leafage that is preferred falls short, they make up as well as they can from what may be at hand in the neighbourhood, and feed till the time comes for them to go down for their chrysalis change, from May onwards, as mentioned above.

The injury from Mottled Umber caterpillars, as well as from others of the same nature, is to be found to a greater or less extent yearly on foliage of orchard (and also of forest) trees, but is especially prevalent when hot and dry weather occurs for a prolonged period in late spring and early summer, the weather being thus favourable to the development of the caterpillars, but not to a sufficiently rapid growth of leafage to counterbalance their ravages.

The year 1896 was a very noticeable example of this. The widespread devastations caused by leafage caterpillars, amongst which those of the Mottled Umber, as well as Winter Moths, played their parts, will be well remembered. In my 'Annual Report' for that year, at pp. 94-96, will be found extracts from 'British Rainfall of 1895,' by G. J. Symons, F.R.S.; and from 'The Meteorology of England' (in the second quarter of 1896), by James Glaisher, F.R.S., giving records of temperature and drought, which are well worth studying in connection with coincident great appearance of leafage infestation in those years.

Just noticing one or two points, it will be seen that there was much drought in May, and also in the *last half of September* in 1895, and relatively to this one of my observers, writing from Maidstone, Kent, mentioned that *Cheimatobia brumata*, the Winter Moth, appeared again in *enormous numbers* in the autumn, as also did *Hybernia defoliaria*, another species of winter appearing moth. This of course greatly

increased the number of eggs which were laid, and caterpillars grown to continue ravage to 1896.

In the following year (1896) the report for the quarter ending June 30th was that the weather was "remarkably fine and bright.* But little rain fell in April and May,—in fact, during May at several stations in the south-west rain fell on one day only. May was probably the sunniest month on record; the general character of the weather during that month may be briefly described as—days bright, cloudless, and hot."

The widely prevalent coincident caterpillar ravage will be well remembered, and is worth referring to as showing that together with this remarkable prevalence of leafage caterpillars we had the weather favourable for this state of things, and that in future recurrence of similar attacks, in similar circumstances, we may expect that (as has now happened) with return to ordinary weather the special prevalence will disappear.

MEASURES OF PREVENTION AND REMEDY for this attack are similar to those given under the heading of Winter Moth.

Plum Sawfly. (For scientific names, see note, p. 184.)

During June, 1891, I received from a few different localities specimens of young Plums infested by sawfly grubs, which were obviously doing much mischief by clearing out the young kernel, and sometimes further injuring the centre of the fruit, and consequently causing it to fall very prematurely.

In one of the first communications which were sent me (received on June 22nd from Urchester, near Wellingborough), the observer mentioned that his Plums were heavily attacked, and that it appeared to him that the attack had been made and the eggs introduced very shortly after flowering, because, when the puncture occurred at the extreme end of the fruit, the exuding gum had often fixed the remains of the flower. "I should say that the creature has injured quite half the crop."—(H. H. S.)

The injured Plums varied in size from about, or a little over, half an inch to an inch in length. In somewhere about nineteen examined, I found the fruit usually to have one boring near the end opposite to the insertion of the stem. In

* See 'The Meteorological Record for the Quarter ending June 30th, 1896,' by William Marriott, F.R. Met. Soc., Assistant Secretary of the Meteorological Society.

a few cases there were two injured spots; the tunnels were sometimes open, sometimes choked with black gummy material. On opening the fruit I found the kernel gone, and often some amount of marks of gnawing round the cavity where the kernel had lain, this cavity being more or less filled with blackish decayed matter.

The larva was rarely present in any of the above-mentioned fruits which I opened, but where present (either amongst these or amongst the specimens sent me from elsewhere), I found them to be twenty-footed caterpillars; that is to say, they were furnished with three pairs of claw-feet, six pairs of ventral sucker-feet, and one pair of sucker-feet at the end of the tail; ten pairs in all.

The general colour of the larva or caterpillar was whitish; head chestnut, darker in front or on the jaws; eyes dark or black. In such specimens as I examined the caterpillar lay curled in the injured fruit, somewhat in the manner of a Cockchafer grub, but when disturbed and placed on the hand, it walked swiftly along it. On further examination a few days later, I found the length of the specimen (exactly measured) was five-sixteenths of an inch, the head pale chestnut, general colour yellowish, the shape somewhat pointed towards the tail, and also it *emitted a strong smell*.

About the above-mentioned date some Plums similarly injured by sawfly larvæ were forwarded to me from the Toddington Fruit-grounds (Glos.), by Mr. C. D. Wise, regarding which he remarked that the infested Plums had been picked and destroyed; and on July 14th he further observed that the grubs must have been about full-grown when they were sent me, and that he did not find these Plum-borers attacked any special kind of Plum more than another.

The infestation was also stated to be bad in the Evesham district, and regarding this point Mr. W. F. Gibbon (Chairman of the Evesham Fruit Growers' Experimental Committee) wrote me on June 29th:—"Last year I noticed a lot of them, and had all the dropped Plums daily gathered up and burnt. This year I find a bored Plum dropped only here and there."

In the case of this Plum infestation, it seems desirable to notice it, as it has a power of doing a deal of mischief; but I have not had special communication about it, excepting in 1891, and only had opportunity of studying it in larval state; therefore I have merely distinguished it at heading by the name of Plum Sawfly. In all points, however, which I had the opportunity of observing, the condition of the infested Plums and the appearance of the caterpillars corresponded with the long and full descriptions of Plum Sawfly given

respectively by Dr. Taschenberg, Dr. Ritzema Bos, and also by Canon Schmidberger,* under different scientific appellations, adding thereby not a little to the difficulties of identification.

The life-history of the Plum Sawfly, as given by the above writers, is in its main points as follows:—The female sawfly begins her operations by making a slit in a calyx-leaf of a Plum blossom or expanding bud. Apparently only one egg is laid in each blossom (or rather calyx). The egg is very small, greenish white, and transparent.

The caterpillar hatches in about from a week to a fortnight's time, and eats its way into the young embryo fruit, where it consumes within what would have been the kernel; and when it has consumed all that suits its purpose for food in one Plum, it goes on to another. This caterpillar is, as we observe of our own, twenty-footed; the colour whitish, or with a reddish yellow tinge; head dark brown or yellow; body lesser towards the hinder extremity, and it gives out a strong bug-like smell.

The caterpillar is full-grown in a period variously observed as from three to four, or five to six weeks. Then the young Plum falls, the caterpillar creeps out, buries itself in the ground, where it spins a cocoon; here it is stated to spend the winter, still in the larval state, and in spring to change to the chrysalis or pupal state, from which the perfect sawfly comes out in time to lay her eggs amongst the opening Plum blossoms. The flies are somewhat like the Apple Sawfly, figured at p. 35, with two pairs of transparent wings; the general colour black or shining black; legs mostly yellow, or of a reddish or brown yellow.

The above notes of life-history are taken from the observations of Dr. Taschenberg, Dr. Ritzema Bos, and Canon Schmidberger, published in their respective works referred to below.

Means of prevention and remedy (also given by the same

* In the 'Praktische Insektenkunde' of Dr. Taschenberg the name given is that of *Hoplocampa fulvicornis*, Klug; in the 'Tierische Schädlinge und Nützlinge' of Dr. Ritzema Bos, it is *Selandria fulvicornis*, Klug, and the internal evidence of quotation in each of these papers shows it to be the same insect, of which a very good account is given by Schmidberger in 'Kollar's Insects,' under the name of *Tenthredo morio*, Fab. A short account of the infestation corresponding with the above, so far as a few lines can correspond with full descriptions, is also given in Kaltenbach's 'Pflanzenfeinde' under the name of *Selandria fulvicornis*, Klug. It is, however, very requisite, in mention of the *Tenthredo morio*, Fab., to notice also the name of the authority by whom it is so called, as the *Selandria*=*Tenthredo morio*, Fab., of Cameron's 'Mon. of the British Phytophagous Hymenoptera' (vol. i. p. 199), and the *S. morio*, Fab., of Taschenberg's 'Insektenkunde,' are clearly different insects from the *T. morio* of Schmidberger, inasmuch as the caterpillar is stated to have a green body spotted with black, whereas the colour of the caterpillar of the kind described above is whitish or yellowish.

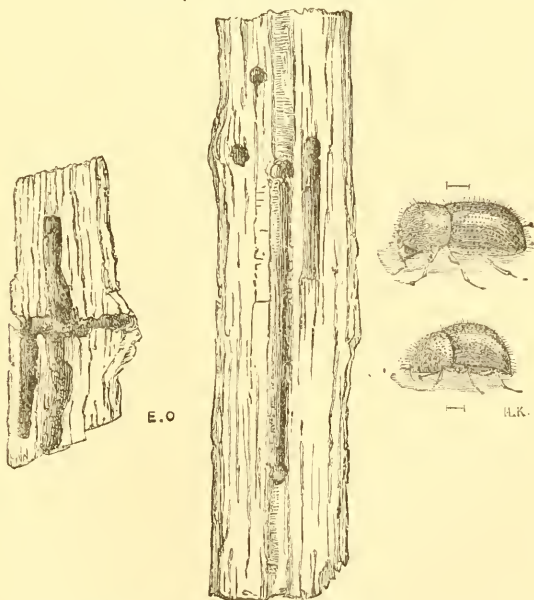
observers) consist, for one thing, in collecting and destroying the infested little Plums before the caterpillar within can leave them to bury itself. This may be done by jarring or shaking the trees, so as to cause the damaged fruit to fall on to cloths spread beneath the trees, and having this fruit immediately gathered together and burnt before the grub within escapes. Or the infested fruit may be picked from the trees by choosing such of the little unripe Plums as show a black spot, where the sap and black rejected matter from the grub have run down its tunnel and show outside.

The black sawflies are sluggish, and when egg-laying, or sucking honey from the Plum blossoms, may be caught by hand where they are in reach on low-growing trees.

See also measures of prevention and remedy for Apple Sawfly, pp. 37, 38.

"Shot-borer"; "Apple-bark Beetle"; "Pear Blight."

Xyleborus dispar, Fab.; *Bostrichus dispar*, Fab.; *Xyleborus pyri*, Peck (of American writers).



XYLEBORUS DISPAR.—Male and female beetle, magnified; lines showing natural length. Plum stems, showing horizontal and perpendicular galleries.

The following observations refer to the serious, and often rapidly fatal, injury caused to young Plum trees by the

Xyleborus dispar, or "Shot-borer," a very small dark brown beetle, which until the year 1889 had been considered to be one of our rarest species, although on the Continent it has been recorded for many years as occasionally doing enormous mischief to various kinds both of young orchard and forest trees.

The injury is caused by the beetles driving their tunnels, so as in the case of quite young trees to partially ring them, and also to clear out an inch or so of the central pith; in the older, though still far from full-grown, trees, although the borings were not so regularly placed, still, from their large number, they interfered with the passage of the sap and did great harm.

In German observations this species has been recorded as seriously injurious to many kinds of trees, as Apple, Pear, and Plum; also to many kinds of Alder, and to Beech, Oak, Chestnut, Maple, and Hawthorn; and it is noticed by Herr Eichhoff as infesting almost any kind of tree, including Conifers.

In America the first observations of it were as being injurious to the branches of young Pear trees; and later on it is noted that Pear and Apple trees suffered from its attacks from Nova Scotia southward. With us, so far as I am aware, it is the Plum which at present has been the only tree to which its attack has been recorded as a regular orchard pest. It may certainly be said to be a widespread trouble, both as to the range of its geographical distribution, and also the many kinds of trees which it infests.

The first information I had of the presence of this beetle was sent me on September 1st, 1889, from the Toddington Fruit-grounds (Gloucestershire), with the observation:—"I enclose a portion of the stem of a young Plum tree, in which you will see a small beetle which has bored its way into the wood and killed the tree. We are losing several trees from the same cause."

Later on, that is, early in December, specimens were sent me of the same kind of beetle (*X. dispar*), with information of it having been present for three years and doing serious damage in a locality near Kidderminster; also that it had done much harm at Hartlebury, a village about four miles from Kidderminster; and also that it was present at another farm in a different direction about seven or eight miles from Kidderminster.

On examination I found that the cause of the injury was the *Xyleborus dispar*, sometimes known as the "Shot-borer" Beetle, figured at p. 185. These beetles are of a pitchy-brown or pitchy-black colour; the wing-cases are of a redder brown

in the male than the female. The fore part of the body behind the head is granulated; the wing-cases have alternate rows of fine punctures, with flat spaces still more finely punctured, and somewhat hairy. The horns are clubbed at the ends, and, as well as the legs, of some shade of yellow or reddish tint.

The great peculiarity of these insects is the difference in shape and size between the male and female (the *disparity*), from which the beetle takes its name of *dispar*. The female is about the eighth of an inch long, narrow and cylindrical, with the thorax (the fore body) large in proportion, and raised in the middle so as to make a kind of hump. The male is only about two-thirds of the length of the female, and much wider in proportion, and the back is flatter. The wings which I examined in the female were well developed, and thickly sprinkled with very short, bulbous-rooted bristles.

The reason of the singularly rapid and complete destruction of the stem of young trees attacked by these beetles was plainly shown on laying open their tunnels. In the specimens of these from Toddington which I examined (figured, life size, at p. 185), I found that the injury began by a small hole like a shot-hole being bored in the side of the attacked stem, from which a tunnel ran to the pith, and a branch about the eighth of an inch across ran horizontally about half or two-thirds round the stem. Sometimes this tunnel was about midway between the outside and the centre, but in one instance quite at the outside of the wood. From these horizontal borings other borings were taken straight up and down the stem; these might be certainly as many as four (perhaps more in one stem), and were from half an inch to upwards of an inch and a half long, and of these tunnels (in the pieces of stem I examined), one ran along the pith, which was completely cleared away. The great injury caused by these galleries fully accounted for the death of the stem.

At the time of examination, that is, on or about September 12th, the tunnels were filled with beetles; where the width only was enough for one, the beetles were arranged in a row one after another in procession, as it were; where the tunnel was a little wider (as where the pith had been cleared away), they were less regularly arranged, but crowded in, so that there scarcely seemed to be room for another. In one length of wood of about two inches I found, as near as might be, thirty beetles. The work of destruction was still evidently going on, for in some instances I found that, instead of being as usual black and discoloured, the sides of the tunnel or the extremity were white and moist, showing the beetles were still feeding. The instinct of tunnelling was so strong at the time,

that a quantity of beetles which I secured in a tube buried themselves so rapidly in the cork, that between the 10th of September and the morning of the 12th they had already bored five tunnels into it, and it contained at least seven female beetles.

A great peculiarity of this attack has been considered to be the extreme rarity of males compared to the number of females, and amongst from about fifty to sixty of these Shot-borers which I took out of their borings in Plum stems in September, I found only one male. Subsequent search, however, made me think that in winter the difference in proportion of numbers would be found to be not nearly so great, for amongst some specimens I examined early in December I found a larger proportion of males, and about a month later, amongst specimens I took (on or about January 10th) from a piece of Plum stem two inches and a quarter across, about seventeen males to six females.

The borings at this winter time of year only contained a sprinkling of beetles, instead of, as in September, being so crowded up that there was scarcely room to insert another beetle into the row that filled each boring.

The method of attack is stated, by the well-known German observer Schmidberger, to be for the beetles to choose a spot, usually on the main stem of the tree, making no distinction as to the tree being sickly or healthy, young or old, so long as it is thick enough for the purpose,—at least half an inch in diameter. (The attacked stems sent me from Toddington were from a little under to a little over three-quarters of an inch across.—E. A. O.) The female then proceeds to bore passages, and in a small chamber at the opening of each of these she is stated to lay her snow-white, longish eggs. The first-hatched larvæ are recorded by Schmidberger as being noticeable about the end of May, and these are considered by him to arrange themselves (in the same manner as the beetles we noticed, as above described), one after the other in the tunnels so as to fill them, and to feed there on a whitish substance with which the passage is incrustated, and there the maggots, according to the observations quoted, turned to chrysalids and thence to beetles.*

The nature of this incrustation, now known to be fungoid, is of great interest, and has been the subject of much discussion from the time of Canon Schmidberger, who described this substance (of which the nature was not then known)

* *Bostrichus dispar*, Schmidberger (*Apate dispar*, Fab.); *Xyloterus dispar*, Erichson. See 'Naturgeschichte der Schädlichen Insecten,' von Vincent Kollar, pp. 261–273; and English translation, 'Kollar's Treatise on Insects,' pp. 254–262.

under the fanciful name of Ambrosia, up to the elaborate observations given, with illustrations accompanying, by Mr. H. G. Hubbard in his paper on the "Ambrosia Beetles," published in 1897, and referred to below.*

Some amount of correct observation was before the public, as in an article published in 1844 by Theo. Hartig, in which he recorded the "Ambrosia" of *X. dispar* as being a fungoid growth; and in 1881 Herr Eichhoff made some degree of observation of the fungoid growth as follows:—"The *dispar* only uses the wood which is still fresh, and full of sap for the brood; this sap soaks ('sweats') so constantly out of the walls of the breeding galleries, that presently this thickens into white-of-egg-like coagulations (called by Schmidberger 'Ambrosia'); and from these the coatings of fungi which have been so often mentioned develop, whereby after a time the surface of the circular galleries become stained black. These coagulations, and occasionally the fungoid growths, serve exclusively for the nourishment of the young larvæ."†

Those, however, who wish to go into the subject in detail will find in Mr. Hubbard's paper, referred to below, much useful information on Ambrosia Beetles and their habits, together with figures of various kinds of "Ambrosia" fungus. At p. 9 Mr. Hubbard states that "the term Ambrosia Beetles is used as a convenient one to distinguish from the true bark-borers and bark-eaters" [the Elm-bark Beetle, *Scolytus destructor*, for example.—E. A. O.], "the timber-boring *Scolytidae*, which push their galleries deeply into the wood, and which feed upon a substance called Ambrosia. . . . Their food consists not of wood, but of certain minute and juicy fungi propagated on the walls of their galleries." These fungi, it is stated, are of different kinds, each species of "Ambrosia Beetles" (or, if not strictly each species, only those most closely allied) feeding on one kind, and one only, of Ambrosia fungus. Also they vary in shape; some, for instance, are like a pile of beads in appearance, whilst the fungus of *Xyleborus saxeseni* (= *xylographus*), referred to further on, is of upright stems set close together, with a swollen cell at the end of each, and not unlike in general appearance, when enormously magnified, to a great number of short, very thick-stemmed pins, with round heads, set very closely together.

The scientific *generic* name of this beetle appears now, after

* See "Ambrosia Beetles of the United States," by H. G. Hubbard, in 'Some Miscellaneous Results of Work of the Division of Entomology,' United States Department of Agriculture, Washington, 1897, p. 24.

† 'Die Europäischen Borkenkäfer,' von W. Eichhoff, Kaiserl. Oberförster in Mulhausen, Elsass. Berlin, 1881.

various changes, to be adopted as *Xyleborus*. With regard to a convenient popular name, that of "Shot-borer," which has become established here, appears as convenient as any for use with ourselves. There are manifest objections to the use of the names of "Apple-bark Beetle" and of "Pear Blight," as referring to only a portion of the trees attacked. "Ambrosia Beetles" is an excellently distinctive *scientific* appellation—referring to them as a fungus-forming class, and also for those who by knowledge and microscopic power can trace out this peculiarity within the workings of the beetles.

But although other beetles form shot-hole-like borings through the bark, still this habit is sufficient to draw attention to the mischief which is going forward in our Plum orchards, and for the present for popular use we do not seem to have any more convenient plan than for this species and *X. saxeseni*, mentioned below, to share for orchard use the name of "Shot-borers."

PREVENTION AND REMEDIES.—One of the most plainly serviceable of these is cutting down and burning the infested portions of all trees—Plum, Apple, or otherwise—found to be undergoing attack, taking the shot-hole-like perforations in the bark and the wood dust thrown out as a guide, to some degree, for investigation of the nature of the mischief going forward within. Where the trees attacked are still young (that is, still only, as was the case at Toddington, about three-quarters of an inch across the stem), the only course to be advised is to cut them down as soon as they are found to be infested, and to burn the part containing the beetles. It is no waste, for in the case of young trees the beetle-borings are rapidly fatal.

For treatment to prevent beetle attack to the growing trees, the only generally available measures appear to be those suggested by Mr. J. Fletcher, Dominion Entomologist of Canada, for use in the Nova Scotia Apple orchards, namely, of coating the trees with some wash or mixture which will not hurt the bark, but will prevent the beetle getting in or getting out. One application advised for trial is a thick coat of whitewash with some Paris-green in it.

Another is the thick soft-soap wash known as "Saunders' Wash," thus noticed:—"Soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water is perhaps as good a formula as can be suggested; this, if applied to the bark of the tree during the morning of a warm day, will dry in a few hours and form a tenacious coating not easily dissolved by rain." *

* Report of Entomologist, Department of Agriculture, Canada, 1887, p. 28.

Where infestation is known to exist in a district, just the same class of measures are useful to prevent its continuance which are in regular use by foresters for prevention of infestation of Pine Weevil and Pine Beetle in woods and plantations.

The "Shot-borer" frequents stumps or fallen trees of the kinds liable to its infestation for breeding purposes, and prefers these (where attainable) to healthy growing material. Therefore it is desirable to remove all such material and burn it early, that is, by the beginning of the warm season; and later on, at the time of summer felling, to remove and burn all infested wood. Further, it answers to set trap wood. These traps may be arranged by setting poles of any kind of wood that the beetles naturally frequent, with one end in the ground so as to keep them fresh for a while, and examining them every three or four weeks, and destroying them if found to be infested. New pieces should be set from time to time, as the beetles require wood with some degree of freshness of sap for their breeding purposes. The season for "trapping" is March to August or September, or later still in the year if examination shows infestation continuing. Felled trees also may be centres of spread of infestation if not looked to, and also stores or timber-yards near orchards may need attention as to infested wood stacked there, which is sure to be a centre of fresh mischief.

Another method of dealing with attacks of *Xylebori*, or "Shot-borers," is plugging up their entrance-holes, in regard to effect of which it is noted at p. 11 of Mr. Hubbard's paper, previously quoted, that by closing the outlets of the galleries through the bark, or by spraying into them kerosine or some other noxious liquid, the contained beetles are so discomposed that they run in all directions, and by trampling on and crushing the young larvæ and eggs, and breaking down the exceedingly delicate fungoid growth, a state of things is induced in which the living insects are destroyed.

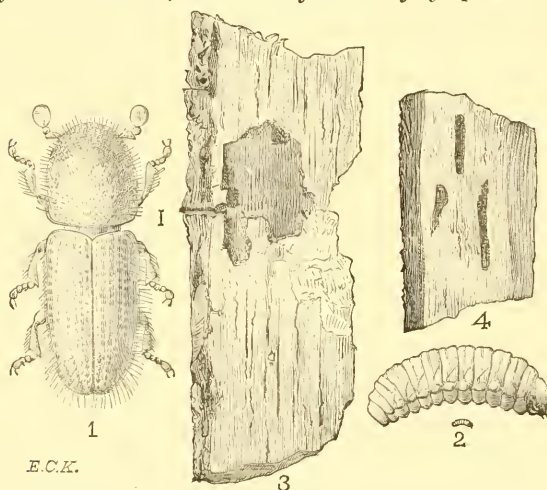
In the same paper, at p. 13, under the head of "Remedies," are the following notes, which I give at length, as the most recent observations on the subject:—

"From what has been said of the nature of the food of these beetles, it is evident that any method by which the entrances to their galleries in the bark can be closed will effectually put an end to the progress of their colonies. Perhaps the best means of accomplishing this is by coating the trunks with *dendroline* or *raupenleim*. A light brushing or spraying of the bark with creosote or kerosine will sometimes accomplish the same result, especially at the beginning of an attack. But this cannot be depended upon to permanently protect the trees.

“Valuable fruit trees which have suffered injury from fire or frost cannot always be protected from attacks of the borers by coating the bark, because of the risk of injury to the buds, which must be allowed to grow upon the trunks. In such cases if borers enter the wood their holes must be plugged. An excellent method is to insert an iron wire as far as it will go, cut it off, and leave the piece in the hole. The inhabitants of colonies thus imprisoned are unable to extend their borings, and inevitably perish.”—(H. G. H.)

Flat-celled Shot-borer Beetle.

Xyleborus saxeseni, Ratz. = *Xyleborus xylographus*, Say.



XYLEBORUS SAXESENSI.—1, beetle; 2, larva—magnified, with natural length of each; 3 and 4, cell, natural size, showing broad and flat and also narrow view.

Up to the date of the observation made in the early part of the year 1897 of the attacks of *Xyleborus saxeseni* to the wood of Plum trees, although the presence of this species in England was known of by entomologists, yet (so far as I am aware) there was no record of it having occurred here as a decided orchard pest, and naturally when the injuries were noticed they were at first attributed to the attacks of *Xyleborus dispar*, which had caused much mischief in various Plum-growing localities for several years previously, and was first reported (from Toddington, Gloucestershire) in 1889.

This infestation, however, may have been present, for the chief observable difference in method of injury, which consists

in the brood cells of *saxeseni* being broad and flat, whilst those of *dispar* are cylindrical borings, is not noticeable until the wood is split open; the beetles also are so far similar that some knowledge of their special characteristics and the use of a magnifying-glass are necessary to make sure of which kind is under observation.

Xyleborus saxeseni is somewhat elongate in shape; the females rather more than a line in length, the males shorter and rather broader. The females black (or sometimes of a yellowish brown) with a small amount of grey hairs; the males wingless, much fewer in number than the females, the brownish colour of a lighter shade, and the hairs longer. This kind may be readily distinguished (see figures, pp. 185, 192) from *X. dispar* (the only species which at present there may be occasion to distinguish them from here) by the female of *dispar* having the thorax (or fore body) large in proportion, and raised in the middle into a kind of hump, while the male, which is only two-thirds of the length of the female in this species, is remarkable for being much wider in proportion, and flat on the back. From all other species of *Xyleborus* it is considered that *saxeseni* = *xylographus* may be distinguished "by the very regular rows of small but sharp teeth upon the declivity of the elytra." *

The matured larva is in colour "yellowish white to yellow; head darker, with dark brown mandibles and brown longitudinal line; . . . body stouter, thoracic segments much larger, and head much smaller in proportion to body than in first and intermediate stages; segments and head sparsely clothed with short fine hairs; length about one line." †

In the course of my own observations, on splitting one of the pieces of Plum wood open, on July 28th, I found two parties of maggots within about two inches of each other. These were of different ages, whitish, and legless, and distinctly lobed, the head very shining white, or, in the older specimens, with a faint yellowish tint (see figure 2, p. 192). Whilst still alive or quite fresh the three first segments appeared to me to be somewhat inflated below, and but slightly corrugated above; the others slightly lobed below, and much corrugated longitudinally above.

In this instance the cell was a flat cavity just inside the

* See "Ambrosia Beetles of the United States," by H. G. Hubbard, in 'Some Miscellaneous Results of Work of the Division of Entomology,' United States Department of Agriculture, Washington, 1897, p. 24.

† Minutely detailed description of the insect from egg to male and female beetle will be found in the paper on "'The Wood Engraver,' Ambrosia Beetle, *Xyleborus xylographus* (Say), *Xyleborus saxeseni* (Ratz.)," by A. D. Hopkins, Entomologist, West Virginia Agricultural Experiment Station, pp. 27-29; published in No. 2 of 'Canadian Entomologist,' 1898.

outer wood, this chamber being about three-quarters of an inch by one-quarter in dimensions of width, and in thickness only about sufficient to accommodate the full-grown larvæ or beetles; and patched over the surface with the white fungoid formation known by writers as "Ambrosia," this being sprinkled with workings of wood-dust, or "frass" of wood.

The smallest size of larva that I measured in the numerous collection was just over the thirty-second of an inch in length; and I found upwards of fourteen larvæ packed together in the inner part of the slit-like cavity, and perhaps a dozen or more besides. From the extreme narrowness of the chamber it was difficult to dissect out the specimens so as to be sure of amount of contents.

I found amongst the above larvæ three pupæ; these were readily observable, even with moderately magnifying glasses, by their bright shiny whiteness; the hinder edge of the thorax was well defined, and so was the longitudinal striation of the wing-cases. The shape is that of the future beetle, only still lying at rest with the developing limbs folded beneath it.

The flat and narrow form of the brood chambers, as figured at 3 and 4, p. 192, is characteristic.

In another piece of Plum stem, of two and three-quarter inches in diameter, which I examined about the same date, I found a horizontal tunnel running from the outside, of about a quarter of an inch in length, on each side of which, beginning at the above distance (one-quarter inch) from the outside of the tree, a flat vertical cell was hollowed out, three-quarters of an inch long at the greatest height, and five-eighths in width. The shape of this flat chamber was somewhat squarish (see figure 3, p. 192), about two-thirds of it being above, and one-third below the mother gallery, of which some traces still remained, and which crossed the flat cell, and then was continued merely as a tunnel (a distinct gallery) for about three-eighths of an inch further, where it stopped, the extremity being filled with about half-a-dozen very young larvæ and a few eggs.

The surface of the flat chamber (as seen in the side remaining after the other side had been cut away in the course of examination) was covered for the most part with a very thin coating of wax-like material, greyish in colour, and with a somewhat sweet scent, and the surface of the wood of the chamber, wherever it was visible, was certainly not of the black colour so noticeable in connection with the workings of *Xyleborus dispar*. It was rather of a brown colour, and moist-looking appearance. This flat cell, or gnawed-out chamber, had only space enough between its two upright sides (see figure 4, p. 192) to accommodate the larvæ, which

were for the most part apparently full-grown, and in many cases not pure white, but tinged with colour, and with the yellow contents of a portion of the length of the food canal showing distinctly.

The above points, of the flatness of the cell and the circumstance of this brood chamber being partially formed by the gnawings of the larvæ, are well described in the following extracts, taken from the notes published during the present year by Mr. H. G. Hubbard, one of the "investigators" of the United States Board of Agriculture*:—"The young in this species are assembled in a brood chamber. . . . It is constructed at the end of a gallery which penetrates deeply into the heart, or remains in the sapwood, according to the amount of moisture in the tree trunk, . . . and stands vertically on edge parallel with the grain of the wood. The space between the walls is not much greater than the thickness of the bodies of the adult beetles. The larvæ aid in extending the brood chamber. They swallow the wood which they remove with their jaws, and in passing through their bodies it becomes stained a mustard-yellow colour. Great quantities of this excrement are ejected from the openings of the colony, but a portion is retained, and plastered upon the walls, where it serves as a bed upon which there springs up a new crop of the food fungus."

The method of life (as observed in the United States) is for the fertilized females to pass the winter in their brood chambers, and emerge in the spring. They are then attracted to sickly, dying, or felled trees, in the living or moist dead wood of which they prefer to excavate their brood galleries. A crevice or opening in the bark, such as may be made by other insects or even by a bird, but more commonly the edge of a wound, or a dead place on a living tree, is stated to be the favourite point of attack.

Apple and Plum are amongst the orchard trees which are especially recorded as infested by this species of *Xyleborus*; and in regard to distribution, it is mentioned by Herr Eichhoff† that "*saxoseni* is not only distributed over the greatest part of Europe, but is also found in the Canary Islands, in North America, and probably also in Japan. Amongst the bark beetles it is a remarkably general feeder, for it lives and breeds not only in the wood of the most different kinds of leafy trees, as Oak, Beech, Birch, Maple, Lime, Poplar, and orchard trees, but also in various of the needle-leaved trees" [as Pine and Fir].

* *Loc. cit.* note, p. 193.

† 'Die Europäischen Borkenkäfer,' von W. Eichhoff, Kaiserl. Oberförster in Mulhausen, i. Elsass, Berlin, 1881, p. 280.

In common with other of the "Ambrosia Beetles," this species is accompanied by a peculiar fungoid growth on the walls of its cells (see *ante*, p. 189) on which it feeds; and in relation to this point it may prove of practical interest to mention that about the beginning of August in 1897 vast numbers of a small black or brown mite were found at Toddington, by hundreds and thousands, crawling on the stems of the *Xyleborus*-infested trees. On submitting these little mites (or *Acari*) to Mr. Albert D. Michael for certain identification, he found them to be *Oribata lapidaria*, belonging to the family of *Oribatidæ*, which amongst other substances prey on minute fungi, and therefore (it may be conjectured at least) may help us in getting rid of the beetles by preying on their special fungoid food.

METHODS OF PREVENTION.—These are for the most part the same which are applicable for lessening amount of *X. dispar*, which have been mentioned in the preceding paper; but it has been suggested in reference to the habit of *X. saxeseni* of making its way into apparently healthy wood through a dead or dying patch on the bark, or a wound, that it might have a good preservative effect if such places were treated by removal of the dead bark, or paring the edges of the wound, and painting the spots with kerosine emulsion (undiluted), grafting-wax, or other dressings of a like character.

Yet another method of action, which it is considered may be effective in destroying infestation when in active life in the tree, is to stop up the entrance-hole by running a piece of wire into it. Thus it is said that the economy of the insects is so disturbed that the beetles in their movements trample down the fungus food, and thus all the contents of the cell are destroyed together.

The preceding notes of the habits of the two species of *Xyleborus* named are given, as far as lay in my power, from English observations; but those who wish to study the most recent observations in full detail will find excellently valuable observations on different genera and species of the "Ambrosia Beetles," with descriptions of different kinds of fungoid growth accompanying their presence, and many illustrations, in the paper by Mr. H. G. Hubbard, of which the title is given at p. 193; and full information regarding *X. xylographus* = *X. saxeseni*, including minute descriptions of the beetle in its various stages, history, habits, and means of prevention and remedy, with two plates embodying about twenty-four figures, will be found in the paper by Mr. A. D. Hopkins noted at p. 193, thus bringing the record of observation up to February, 1898.

Fruit-tree Bark Beetle.*Scolytus rugulosus*, Ratzeburg; *S. hæmorrhous*, Schmidt.

SCOLYTUS RUGULOSUS.—Beetle, larva, and pupa; all greatly magnified. The two latter from drawings by Mr. R. Newstead.

The above-named beetle much resembles the well-known Elm-bark Beetle (*Scolytus destructor*, Oliv.), in its method of doing harm by working in larval state within the inner part of the bark and outer part of the wood, but is distinguishable (for one thing) by being a good deal smaller, the Elm-bark Beetle being from one and a half to as much as three lines in length, and the “Fruit-tree” *Scolytus* only from three-quarters of a line or less, to a line and a quarter long.

The infestation has long been known on the continent of Europe, and noted as feeding in the bark and sap-wood of various trees, especially Apple, Plum, and Cherry. In the United States “available data indicate that Plum is more susceptible to attack than other trees; while Peach, Cherry, and Apple are attacked about equally. Pear is also quite subject to infestation; and Apricot, Nectarine, and Quince trees are known to have harboured the species.”* In this country it has not been (so far as I am aware) noticed as more than “rather common” until 1895; and until I received in that year specimens of small boughs of Plum much injured by its presence, I was not aware of it being one of our decided orchard pests.

On the 7th of June, Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, wrote to inform me that he was sending me some pieces of Plum branches infested with *Scolytus rugulosus*, of which he observed:—“By carefully removing the bark you will find the insect in all stages, *e. g.* larva, pupa, and imago. The branches are from Plum trees in my father’s garden at *Ince*, *Cheshire*, where the attack has

* See Circular, No. 29, Second Series, United States Department of Agriculture, Division of Entomology. By F. H. Chittenden, Assistant Entomologist. Washington, March 25th, 1898.

proved most destructive, as also at other gardens in the same village. I have also received it from Shropshire, where it had been equally destructive. I have now had the species under investigation for nearly two years."

Mr. Newstead kindly lent me his own drawing from life of the maggot and pupa much magnified, which, with his permission, I have had copied, and insert at p. 197.

The specimens sent were very characteristic of the method of attack. The life-history is that the little beetles appear in April or May, and begin to bore into the bark, and the females tunnel their vertical galleries between the inner bark and sap-wood. Here they lay their white eggs singly side by side along this "mother-gallery," and from these eggs the grubs hatch after a few days, and feed on the inner bark by preference, but otherwise in the sap-wood. The maggot-tunnels necessarily all start off, as with so many of the bark-beetles, at right angles from the mother-gallery, by the sides of which the eggs were laid; and when full-fed, if there is still a good thickness of bark over them, they turn to chrysalids at the ends of their tunnels; otherwise, if the bark is too thin a protection from their having eaten it away, or from other causes, they pierce a little way down into the solid wood.

This was very observable in the small branches sent me. At first, from the short boring down into the wood being stopped at the entrance by the powder (frass), the results of the feeding of the grub, the perforation was very likely not noticeable; but later on, when the beetles had developed and emerged, the minute cylindrical holes down into the wood were as observable as those through the bark, and were sprinkled in such numbers in the Plum branches sent me, that I counted sixty perforations at least in a space of one inch in width by two in length, the short tunnel varying in depth from about the sixteenth to over the eighth of an inch, and often entering the wood in a slightly slanting direction.

The first round perforations through the bark are made for *entrance* holes by the beetles; presently, if the brood of beetles comes to maturity each at the end of its larval tunnel, they will pierce their way out, and the bark will be sprinkled with the round shot-like holes they have made as *exit* passages. Where there is only a small quantity of attack the characteristic form of the vertical mother-gallery, with maggot-galleries starting at (more or less) right angles from it, is clearly observable; but where much infestation is present the various galleries may intersect each other, and the larvæ instinctively diverge from their straightforward course to avoid the tunnel of an adjacent larval worker, so that the workings are irregularly interlaced.

The accompanying figure of an infested Apple-twigg, with part of the bark removed, shows injury just underlying the bark in irregular workings and perforations through the bark.* The beetle is of the shape figured, magnified, at p. 197, and shining, but, on account of its wrinkled surface, not so much so as the rather larger kind the *Scolytus pruni*. The fore body is extremely closely covered with deep oblong punctures, confluent into wrinkles in front and at the sides. The colour is black, with tips of the wing-cases, horns, and legs, or a portion of them, red or reddish brown; the wing-cases have punctures on the interstices as large and deep as those in the striae. The length of the beetle is about the tenth of an inch; and the abdomen is shorter than the wing-cases.

The larva, figured at heading, is white, with small yellowish head, and brown mandibles, and surface wrinkled. The pupa is also white.

According to Dr. Taschenberg, the development of the beetles from the first-laid eggs is completed by the end of June. This agrees with the state of the specimens sent me by Mr. Newstead. Of these, on June 21st, I found the beetles had been developing numerously. The dust which had dropped from their workings induced me to make a careful examination as to what had been going on, and at first only a few of the beetles were noticeable in the box; but, on moving the pieces of infested branches, I found that numbers of them were present, running about fast and actively.

With regard to the number of successive broods that there may be in one year, this appears, from the comparison of observations given in Mr. Chittenden's paper previously noticed, to depend very much on climate. Formerly it was supposed by continental observers that there was only one generation annually; now it is known by U. S. A. observation that there may be four or five. I have not had convenient opportunity for tracing out this point myself in this country; but from specimens and observations sent, the attack is obviously one that needs watching against and careful keeping in check.

PREVENTION AND REMEDY.—One important measure is (as in the case of the Elm-bark *Scolytus*) to remove all centres of



Work of *S. rugulosus* in Apple-twigg; natural size.

* From original drawing, p. 2, of Mr. Chittenden's paper previously referred to.

infestation. If infested trees are found to be dying, they should be cut down and burnt; and boughs or twigs, such as that figured at p. 199, should be cut off also and burnt.

Where there is only moderate attack, the trees should be gone over to ascertain what is needed, and treated accordingly. The time of the emergence of the beetles may be known by the appearance of the little perforations like shot-holes in the bark, and the fine dust from the workings of the insect that has fallen from them. In the case of the pieces of branches which were sent me there was a good deal of this "frass" thrown out. Where the *Xyleborus* or Shot-borer Beetles are also present, it may be necessary to strip some small pieces of bark to ascertain whether the "shot-holes" are caused by "borers" whose tunnels will be found, as with the *Scolytus* under consideration, lying (probably in great numbers) superficially on the outside of the wood, and beneath the inner coat of the bark, and only occasionally entering the wood for a very short space (see p. 199); or, like the *Xylebori*, piercing into the solid wood before commencing further damage.

Various washes have been recommended to prevent perforation of the bark by the beetles for egg-laying purposes, of which one of the most likely to be successful is that recommended by Dr. W. Saunders, Director of the Experimental Farm of the Dominion of Canada, for prevention of various kinds of fruit-tree bark-borers. This consists of soft-soap reduced to the consistency of a thick paint by the addition of a strong solution of washing-soda in water; "this, if applied to the bark of the tree, especially about the base or collar, and also extended upwards to the crotches, where the main branches have their origin, will cover the whole surface liable to attack; and if applied during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain."* A protective coat of this mixture given when the beetles are emerging (which may be known, as above mentioned, by the frass, or wood-dust, thrown out from their borings), and another application somewhat later, would most likely answer well.

For special application where it is desired to protect valuable trees from infestation, Dr. Taschenberg recommends the use of Leinweber's mixture. A recipe for this will be found in Prof. W. R. Fisher's useful work referred to below†:—"Five pounds of tobacco mixed with half a pailful of hot water, kept hot for twenty-four hours; the water is then

* See 'Insects Injurious to Fruits,' by W. Saunders, F.R.S.C., &c., p. 19.

† 'Forest Protection,' by W. R. Fisher, Assistant Professor of Forestry, Royal Indian Engineering College, Cooper's Hill, &c., p. 250. London: Bradbury, Agnew & Co., Bouverie Street. 1895.

squeezed out of the tobacco, and mixed with half a pailful of bullock's blood, one part of slaked lime, and sixteen parts of cow-dung. This is kept in an open tub, and stirred once a day, and used after fermentation has set in. The rough bark-moss, &c., is trimmed off the tree, and the latter painted with the mixture for three successive days, until a crust is formed which the rain will not wash off." The very disgusting application may possibly act in some degree by the smell of the putrefying animal matter so entirely overcoming the vegetable odour, that the beetles cease to be attracted to their regular host-plants.

Two other kinds of dressings,—one known in Germany as "raupenleim," the other the application known in America as "dendroline,"—have been suggested as possibly useful, both as keeping out external attack, and preventing escape of what may be within.

Both of these materials are stated to be crude petroleum products, of the nature of an impure vaseline, of a greasy consistency at ordinary temperatures, and absolutely resisting wash by rains.

The "raupenleim" is stated to harden into a crust after a time, and the "dendroline" to have a tendency to become absorbed; also it is said that no insect will rest upon these materials long enough to lay an egg, and that no larva can bore through a coating of them to reach the trunk of the tree.*

Should these "preventives" be introduced into this country, they might prove of great service against Winter Moth attack if applied similarly to "sticky banding" and with similar care, especially in the case of "dendroline," to avoid risk of the application soaking into tender bark.

But with regard to remedial measures for the *Scolytus* attack under consideration, probably the fairly effective plan of clearing and burning infested trees or parts of trees will be the method generally preferred.

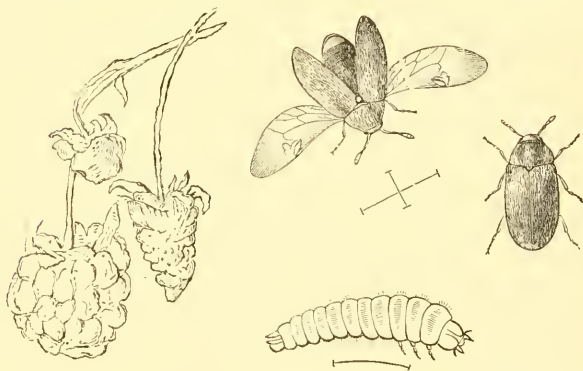
* For details and cautions in use of these preparations, more especially of the dendroline, see 'Economic Entomology,' by Dr. John B. Smith, p. 431. Philadelphia: J. B. Lippincott Company.

QUINCE.

Attacks to the Quince have scarcely ever been reported to me, and amongst these none that are peculiar to this tree. The names of various infestations to which it is subject in common with other orchard trees will be found in the list of fruit trees and bushes (arranged alphabetically, with the names of the attacks to which each kind is subject) placed preceding the Index.

RASPBERRY.

Raspberry Beetle. *Byturus tomentosus*, Fab.



BYTURUS TOMENTOSUS.—Raspberry Beetles, much magnified, with line showing natural length; maggot, magnified, with line showing natural length, after sketch by Prof. Westwood. Raspberry fruit.

The Raspberry Beetles are to be found in spring (after they have developed from the chrysalis state, in which they have passed the winter) infesting various kinds of flowers, but especially those of Raspberries. As a fruit infestation this beetle affects Raspberries and Blackberries, and is to be found widely distributed over the country; reports of its presence have been sent me from various localities in Kent, and as being very noticeably present in 1891 (the year of its worst

appearance) in the Toddington Fruit-grounds in Gloucestershire. It was also present at various places in our more easterly counties, and in Scotland was very injurious as far north as Newton, near Glasgow, and, judging by descriptions published about June 30th in the above year, also did much harm in the neighbourhoods of Scone, near Perth, and Alyth, on the borders of Perthshire and Forfar.

On May 28th, 1883, I received a communication from Mr. H. Wood, of Crockenhill, St. Mary Cray, Kent, regarding a small brown beetle, which proved to be the Raspberry Beetle (*Byturus tomentosus*), which was causing fearful havoc, and entirely devouring the Raspberries. Of this he mentioned that he had "noticed this insect in the Raspberries for some years, but never so numerous as they are this season; . . . they have appeared rather earlier than usual, piercing the bloom before it has expanded (this shown by specimen sent). They generally enter the bloom after it has expanded, and then eat completely through it. This insect is a fearful pest; the fruit-growers in this neighbourhood complain most fearfully of it."

The above was the only communication that I received of the attack being of serious importance until 1891 (the date of the following observations), nor have I had any since.

Byturus tomentosus is a small beetle about one-sixth of an inch in length, of some shade of brown, which may vary from pitchy to reddish or yellowish, but covered so thickly as to conceal the ground colour with a yellowish or grey down, from which it receives its specific name of *tomentosus*. The wings (see figure, p. 202) are ample. The antennæ, or horns (which are thickened towards the extremity so as to be somewhat club-shaped) and the legs, are reddish yellow, or reddish yellow with a brown tinge.

The injuries are commenced by the beetles attacking the bloom of the Raspberry, or even eating their way into the unopened flower-buds. The earliest notes I have received of attack were on the 26th of May, when the beetles were attacking the buds; somewhat later, another of my correspondents mentioned:—"I first noticed them when the flower-buds were forming; apparently piercing a hole in each bud. Now, as the buds are opening, they seem to be eating the stamens and petals. I have killed quite two hundred in a short time, generally two on every bud."

Mr. John Speir, writing from Newton Farm, near Glasgow, on the 13th of June, observed:—"The enclosed small brown beetles are making considerable havoc on the remaining canes of my Raspberries. They eat away the flower-bud."

With advance of the bloom the whole of it is liable to be

cleared away. A correspondent, near Dartford, forwarded me *Byturus* beetles with Raspberry blossom which they had injured, and a few days later forwarded more beetles and Raspberry blossom in various stages of consumption, with the further observation:—"You will see that it is quite finished off, and if some remedy is not found the whole crop will be destroyed."

From an Essex locality the same attack was noted as that "of a little beetle that attacks the bloom of the Raspberries, and appears in some instances quite to destroy it"; and further, that "it was found quite at the bottom where the fruit is forming."

Another observer mentioned of *Byturus*, with specimens accompanying:—"There are sometimes five in one flower. They fly readily. They lie in the trough round the base of the embryo fruit."

All the above observations, it will be noticed, refer to the attack of the *Byturus* beetle to the *flower or blossom-bud* of the Raspberry, the first application being sent on the 26th of May, and inquiries or remarks on presence of attack being continued until the last day of June. This injury, however, which is caused by the beetles to the blossoms is only one portion of the mischief. Following on this is the harm done by the *maggot in the Raspberry fruit*. Of this I received very thorough examples from Toddington, sent me by Mr. Wise on the 19th of August with the following observations:—

"I am sending you some Raspberries, which will, I fear, arrive in a pulp, but at this time of year they are so very soft. In them you will find a quantity of grubs, and our Raspberries are infested with them. Can you tell me what they are?"

These I carefully identified as being maggots of the *Byturus* beetles of which so many had been seen earlier in the year, and of which the chief characteristics are given below; and on forwarding the information I received the following note from Mr. Wise:—

"I looked out the Raspberry Beetle, and thought they were our old friends. I think they are more plentiful this year than I have ever seen them, and you will remember in the spring of the year we were very much troubled with the beetle."

The maggots of the *Byturus* beetles grow to a length of about a quarter or five-eighths of an inch, and are cylindrical, somewhat depressed in front, and lessened at the hinder extremity, which is terminated above by two brown curved points, and beneath with a cylindrical tubercle employed as a pro-leg. They have three pairs of moderately long hairy

feet. The colour is yellowish, with brownish yellow on the back, and the head brown.

When the Raspberries are ripe, the maggots are stated by our chief writers on the subject to leave the fruit and seek for some cranny under the bark or in the wood of the Raspberry stem, or some similar sheltering place, where they form a cocoon or case in which they turn to the pupal state, in which they pass the winter, and from which the beetles come out in the following spring to attack the Raspberry blossoms.

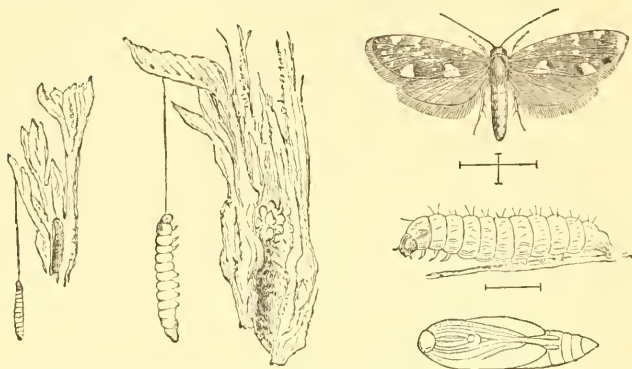
PREVENTION AND REMEDIES.—The most available method appears to be shaking off the beetles in such a manner that they may have no chance of escaping and flying back to the Raspberry blossoms, and no better plan appears to have been mentioned anywhere than the treatment which Mr. Wise wrote me was carried on at Toddington: “We have been shaking the bushes over bags soaked in paraffin with excellent effect.”

Anything, as, for instance, cloths, tarred boards, or baskets tarred inside, on to or into which the beetles would fall, and from which they could not escape by reason of their being either poisoned or stuck fast, would answer well. But in any case the operations should be carried on early in the morning, or when the beetles will be dull and sluggish. “*On hot days these little beetles fly away directly they are alarmed.*”

If it was possible to have the fruit which from its ruined condition is noticeably infested by the maggots *gathered and burnt*, this would save much recurrence of attack.

The only other available methods of prevention appear to be—1stly, so to clear away all old wood and places in which the chrysalids may be sheltered, that they may thus be (to a great measure) got rid of on the bushes; but, 2ndly, it seems not unlikely that, as these little chrysalis-cases are stated to be formed in crannies under the bark or in the wood of the Raspberry stems, there may be many hidden about the bearing-stems of the past season which are regularly cut away in course of ordinary treatment. If so (*unless these trimmings are destroyed*), the beetles which come out from them in spring would be a most fertile source of infestation to the neighbouring blossoms. As in any case the old bearing wood must be cut away, it would add little to expense (where this is not already practised) to burn it, and it might be that this would strike at the root of much further mischief.

Raspberry Stem-bud Caterpillar. *Lampronia rubiella*, Bjerk.



LAMPRONIA RUBIELLA.—Moth, magnified, and with lines showing natural size; caterpillars, natural size, and somewhat magnified, from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood.

The mischief caused by this attack in its commencement may be readily known from that caused by the *Byturus* beetle and its maggot, mentioned in the foregoing paper, by reason of it affecting the inside of the young *leaf-buds*, or *shoots*, or *pith*, whilst the beetle attacks the *Raspberry blossom* or *blossom-buds*. In both cases egg-laying takes place in the flowers.

The infestation was described by Prof. J. O. Westwood as long ago as 1853 in the volume of the 'Gardener's Chronicle' for that year, with good illustrations accompanying, from which I borrow the much magnified figures of the caterpillar and chrysalis given above, and from time to time the same attack has been noticed; but I never received any special report of it as markedly injurious until 1883, when I was indebted to Mr. Jenner Weir, F.E.S., for observations of the habits of the larvæ on Raspberry shoots in his garden at Chirbury, Beckenham, and also for identification of caterpillars as being those of *L. rubiella*.*

Since the above date, though the attack did harm in various places, the only bad outbreak of which I have had information

* The many appellations that have been bestowed upon it, of which the list is given by Prof. Westwood in his excellent paper on this insect ('Gardeners' Chronicle,' 1853, p. 757), are of some interest, as showing the great difficulties which variety in scientific names causes to inquirers. The moth was *Tinea corticella* of Linnæus; the Swedish naturalist, Bjerkander, named it *Tinea rubiella*; it was placed by Stephens in the genus *Lampronia*; Fabricius named it *Alucita variella*; Duponchel gave the specific name of *multipunctella*; Sodofsky that of *Fischerella*; and it is stated to be *Glyphipteryx variella* of Stainton's 'Catalogue of Tineidæ.'—E. A. O.

was that in 1891, which gave opportunity of adding some very serviceable observations, and especially those of Dr. T. A. Chapman, F.E.S., to what was previously known of its life-history.

In that year (1891) the observations sent showed the attack to be present at a good many localities in the more westerly of the midland counties, and in Kent, and as far north as Glasgow, and at Crieff, in Scotland.

The Raspberry Stem-bud Moth caterpillars are about a quarter of an inch long, of some shade of red, with black head, and black mark on the following segment; they have three pairs of claw-feet, which are black, and also four pairs of sucker-feet, and a pair at the end of the tail. When examined through a magnifying-glass it will be seen that there is a pale line down the centre of the black head, and that the mark on the following segment is composed of a pair of double-spots.

The attack is begun in spring by the little caterpillars (which live in caterpillar state through the winter) piercing into the young leaf-buds, and with the advance of the season the mischief becomes very noticeable by the fading of the young shoots from buds which have been injured, but not destroyed whilst still in bud condition.

On the 30th of April Mr. Speir wrote me from Newton Farm, near Glasgow, N.B., that on that day he had seen a large number of small scarlet maggots on his Raspberry canes (on almost every other cane). These were about three-sixteenths of an inch long and one-twentieth thick, with black head, and small black spot on the tail, otherwise all bright red. It was observed that up to a couple of days previously there had been no mild weather since February, and it was only within that time that the buds had begun to swell. Most of these maggots were found crawling on the canes, but quite a number were just emerging from the buds, and on cutting off a number of buds, either a burrow from the base to the apex, or a maggot in the base, was found in a great many of them.

The above note of the caterpillars not contenting themselves with the destruction of one bud, but emerging and travelling on the cane to renew attack at pleasure, is important practically, and was noticed by several correspondents who made this habit a matter of special observation.

Mr. Wise, writing from Toddington, remarked:—"I have found in cases where there are two shoots the caterpillar has been in one and left it, and evidently gone into the next, for in the next I have found it."

Another correspondent, writing from Crieff, N.B., on May 7th,

mentioned that there many of the buds had been entered when they had scarcely begun growth; also that "while I believe that the caterpillar does not leave the bud when once he has penetrated to the pith of the cane, where he makes his lair, I think that he may often nibble at one or two buds on his way up the cane, and thus destroy them before finding one which pleases him as a permanent settlement. Specimen 2 shows three lower buds which have been seriously bitten, while the only nest is in the fourth or topmost bud."

On May 18th specimens were forwarded me of *L. rubiella* caterpillars then beginning to *spin up and change to the chrysalis state*, with the remark:—"I am sending you specimens of a small red caterpillar which is attacking the Raspberries this year; it has eaten all the first buds, and eats its way into the cane itself."

One of the caterpillars sent had spun up except at head end; colour become yellower below. A chrysalis (spun up in web in the bud) was tawny or reddish yellow on as much of the back from the head onwards as was visible. The wings, which were folded beneath it, were yellowish. The abdomen was of a full pink.

The above observation was satisfactorily completed by a characteristic specimen of the moth, *Lampronia rubiella*, developing from a chrysalis in one of the Raspberry buds sent me. This I first observed to have emerged on June 1st.

The following are the main characteristics of the appearance of the moth (see also figure at p. 206):—The expanse of the wings is a little under half an inch. The head ochry grey with yellowish face; horns dull brown. The fore wings shiny, with a brown ground, marked with yellow dots and various yellow spots; of these spots two are very noticeable on the hinder or inner margin, and there are four smaller spots on the costa or fore edge. The fringes are brown, with tips white at the end of the wing. The hinder wings brown, with paler fringes.*

As the attack advanced, notes were sent of the *young shoots* failing from the presence of the pest within, almost as if they had been frost-bitten, in one case to the extent of from ten to fifteen acres being "so badly damaged that they looked as if it might be the middle of winter; and at the visit of the Evesham Fruit Experimental Committee to the Toddington Fruit-grounds, on the 12th of May, a large basket was shown filled with Raspberry shoots infested by the caterpillar of

* For description in precise scientific wording, with synonyms of the species, see Stainton's 'Tineina,' p. 39. From specimens sent me I had opportunity of noting the colours of the chrysalis spun up in the bud (to which I give one reference above), and which I am not aware of having been recorded before.—E. A. O.

Lampronia rubiella, as a sample of several other basketfuls which had been collected in the previous part of the day.

The above observations describe the method of the caterpillar attack and the injury it causes; but the part of the life-history as to where the moth (which is known to be common in June) *lays her eggs*, and where the young caterpillars feed until they shelter for the winter, was, I believe, unknown (or only vaguely and in very small part noted) until observed and recorded in 1891 by Dr. T. A. Chapman, of Hereford.*

Dr. Chapman wrote:—"The egg of *L. rubiella* is laid when the Raspberry is in flower; I have twice seen the process take place, and on one occasion besides saw it fail. The moth selects a fully opened flower"; here Dr. Chapman gives a minutely detailed account of the operation of egg-laying, culminating in the egg being inserted in the "receptacle" of the flower so as to lie about its own width beneath the surface. In the case of failure mentioned above, the moth had attempted to lay on a not fully opened flower.

Further, quoting Dr. Chapman's words:—"When the Raspberry is ripe, and is removed by human or other agency, the larva of *rubiella* is in the fleshy white receptacle,† but is ready to quit it, and does so immediately. In one such receptacle were two larvæ. So far as I could see, their presence does not interfere with the due development and ripening of the fruit."—(T. A. C.)

From further observations, Dr. Chapman found that the larva spins itself a little round, flat, white, silk cocoon not much more than the twelfth of an inch in diameter, and that on its leaving the "receptacle" (which he notes may be in the way mentioned above, or by boring a way out at the base by the footstalk) it no doubt goes down to the stool of the plant, and passes the winter in such a cocoon as he describes, from which it emerges in the spring.

Thus (to recapitulate) the life-history of this infestation is that the moths lay their eggs when the Raspberry flower is open, placing them just beneath the surface in the "receptacle." There they grow until the Raspberry is ripe, when they are full-fed, when they leave their feeding-ground, as above mentioned, and pass the winter in a cocoon, from which they come out and spread themselves in the following spring on the Raspberry canes, and attack the buds even in their first show of growth.

* See "The Oviposition and Autumnal Larva of *Lampronia rubiella*," by Dr. T. A. Chapman, in 'The Entomologist's Magazine' for June, 1891, p. 169.

† For figure of "receptacle" of Raspberry fruit with the berry removed, see sketch at p. 202.

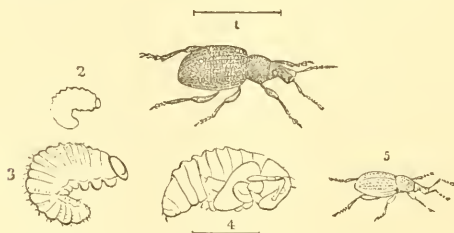
PREVENTION AND REMEDIES.—One of the most effectual methods of checking recurrence of attack must certainly be that mentioned above, of breaking off the infested buds, or little shoots, and destroying them. This method of clearing the pest, however, requires some care in carrying out, for, as has been shown, the caterpillar by no means necessarily remains in its own bud. To prevent escape, the buds, or embryo shoots, might be cut into pails with a mixture of soft-soap or of any sticky fluid in them which would prevent the caterpillar crawling away, or a rough lining of canvas to the collecting baskets which would allow of a good sprinkling of paraffin oil (or of anything that the grubs would not cross at the edges), would probably be a good plan.

In any case the broken-off buds and shoots should be burnt or destroyed in some way as soon as possible, or otherwise, in case the caterpillars are so nearly full-grown as for the time of their change to chrysalis state to be at hand, almost as plentiful a development of the moth may be expected from the gathered shoots as if they had remained on the bushes.

No attempts appear to have been made at present to prevent the attacks of the little red caterpillars when they come out from their small white silky cocoons, or from the sheltering places in which they have passed the winter. But when there is reason to expect bad attack, it might be worth while to try the effect of some preventive dressing thrown round the bases of the canes; and a much more complete removal of old stumps and rubbish and everything that would shelter the infestation in its winter state than is commonly carried out, would certainly be very helpful in getting rid of a deal of coming infestation.

Clay-coloured Weevil. *Otiorhynchus picipes*, Fab.

Black Vine Weevil. *O. sulcatus*, Fab.



OTIORHYNCHUS PICIPES and *O. SULCATUS*.—1-4, *O. sulcatus*, maggot and pupa, natural size and magnified, or with lines showing natural length; 5, *O. picipes*.

The two kinds of weevils figured at p. 210 have an enormous capacity for doing mischief by feeding in beetle state on leaves and shoots, or even fruit above ground, and in larval state feeding on the roots of the same kinds of plants; but of these the Black Vine Weevil only needs a slight mention here, as, though sometimes injurious to Strawberries, it is chiefly known for its injuries to Vines, and sometimes to Peaches; likewise for its injurious attacks in collections grown by florists of Primulas, Saxifrages, or other low-growing plants, and (very especially) to Maidenhair Ferns. The beetle (figured at p. 210, magnified) is a little over four and sometimes five lines in length, and is of a dull black, with a short snout or proboscis; the body between the head and the abdomen is granulated, and the wing-cases are rough, with several raised lines, and spotted with pale hairy tufts, and, like the other species of *Otiorhynchus*, it has *no wings*.

O. picipes, or the "Clay-coloured Weevil," is sometimes a general trouble; during this year (1898) it has been especially reported to me as doing harm to Apple, Plum, Raspberry, Gooseberry, and Hop; previously (with specimens of injury caused by its attack also sent) to Damson, Cob Nut, Raspberry, and Strawberry. It differs from the "Vine Weevil" in being rather smaller, from three to three and a quarter lines in length, and is of a brown or testaceous colour, mottled with patches of brown or grey scales, so that when only slightly magnified it looks of a mottled clay colour.

The habit of life of the above-mentioned weevils is to lay their eggs a little below the surface of the ground; from these eggs there hatch legless, whitish, fleshy, and somewhat hairy maggots (see figure, p. 210), with yellow or ochrey heads and jaws, by means of which they do great damage to the roots of the plants on which they feed.

The maggots may be found in the ground, as in Vine borders, or at the roots of Raspberries for instance, from August onwards, and in the spring—that is, about April—they turn to chrysalids in the ground not far from the surface, the depth probably varying with the kind of soil. From these chrysalids, which much resemble the beetles in shape, but have the limbs folded beneath them, and are whitish or yellowish, and without power of movement until fully developed into weevils, change to this state soon takes place.

The following communications give some idea of the severe injury caused by the attacks of *O. picipes* to Raspberry canes. The first was sent me by Mr. Arthur Beale, from Covent Garden Market:—"I enclose herewith some specimens of a beetle that does considerable damage to Raspberry cane, in some instances completely killing the plant by biting out the

buds and young shoots. I brought the enclosed specimens from a plantation in Kent on Saturday. . . . We have been killing great numbers by smoothing the ground round the plants, and then laying a few large clods about, under which we usually find large quantities the next day, and so destroy them; but this we find a costly and tedious cure, and wish to know if any other remedy can be suggested.”—(A. B.)

The very worst account, however, of destruction caused by this species was that of Mr. John Thomas, of Ridgeovean, Gulval, Cornwall, giving an account of severe mischief over a large area occurring in 1878 and 1879.*

In 1878 the whole of the canes in the Raspberry gardens (which extend over two acres of land) were stripped of their shoots, and the crop consequently sacrificed, causing a loss of upwards of £100.

In the following year, 1879, Mr. Thomas, on examination of his Raspberry bushes at night, found the brown weevils gnawing through the succulent stems of the blossom-shoots, some consequently withering, some being cut right off. At the approach of daylight the weevils went down to the ground, and hid themselves just below the surface, or underneath stones.

Hand-picking, strewing the ground with lime, and daubing the feet of the canes with coal-tar, were tried as remedies, but found to be either insufficient or useless.

The observer then had a number of wooden trays constructed, the insides of which were smeared all over with tar. The Raspberries were planted in clumps, and bent into arches. After dark one man held a tray beneath an arch, another carrying a lantern gave the bush a smart tap, and the weevils fell into the tray; the tar held them prisoners for a time, and after the tray had been placed under a bush or two, the weevils collected were killed by pouring boiling water over them. It was found necessary that the water should be *quite boiling* to effect this thoroughly. Mr. Thomas had thirty or forty persons at this work on his grounds, and each bush was treated three times in this way.

Other Raspberry grounds were reported as being similarly attacked; and in 1878 Raspberry plots in the large fruit gardens in Gulval and in part of Madron (also in Cornwall) were almost totally destroyed at a loss of many hundred pounds.

The above notes show the power of this kind of beetle in injuring Raspberry growth, which, though twenty years have elapsed, is shown by communication of the present year to be still going on, and though in these observations the harm

* I copy the notes as I recorded them in my Annual Report for 1879.

done by the beetle maggots at the roots is not entered on, it is to be remembered that in regular course of life-history the *legless* maggots of these *Otiorhynchus* beetles feed on the roots of the plants on which the beetles prey when they have completed their changes in the ground.

With regard to damage by the same kind of infestation (namely, *O. picipes*) to Strawberries, the following communication, sent me on the part of Mr. Thomas May, of St. Mary Cray, Kent, shows its enormous powers of devastation to this crop also:—"I send you herewith two boxes containing grubs and beetles; they are from a Strawberry field which has been completely destroyed by them. You will find a cocoon in which a grub is ensconced, also grubs partly transformed into beetles, and also a complete beetle. These have been taken from the field of Mr. Thomas May, of St. Mary Cray." Requests for information as to the nature of the pest were sent accompanying, and also mention that Mr. May considered *he had lost* £500 *by its ravages*.

In the case of this attack, of which the notes were sent on the 30th of May, the specimens were in different stages of development, from half-grown grubs up to the perfectly developed weevil, showing the species to be *O. picipes*.

From the exceeding resemblance of the grubs of *O. picipes* and *O. sulcatus*, it is next to impossible to identify them specifically without rearing some to maturity; but taking them generally as presumably of one of our common kinds of *Otiorhynchus* larvæ, I have had specimens sent me at the date of February 18th in mild and open weather, which were then working mischief steadily by gnawing chambers in the thick parts of Strawberry roots; and earlier in the year—that is, in the month of January—I have had specimens of *O. sulcatus*, in beetle and pupal state, sent me from Maidenhair Ferns. Severe cold does not appear to affect them, for in the case of some observations made by myself on larvæ of *O. sulcatus* in February in another year, when they were exposed in earth in flower-pots to cold reading as low as 11·8°, they appeared with scarcely any exception uninjured by the low temperature. The larvæ were frozen stiff, but gradually regained flexibility, and as afterwards I found *O. sulcatus* at work in my garden, where it had not been before, I presumed that practically as well as experimentally the grubs were none the worse for having been frozen hard.

A third species—*O. tenebricosus*, or the Red-legged Weevil—is also mentioned by John Curtis, in the 'Gardeners' Chronicle' for 1842, p. 316, as being very hurtful to garden fruit trees. The beetles feed on the buds, young shoots, bark, leaves, &c., of Apricots, Nectarines, Peaches, Plums, &c.; and

have been found also, in the maggot state, doing much harm to the roots of Raspberries, Currants, Gooseberries, Strawberries, and to vegetables.

This weevil, when recently developed, has the wing-cases dotted over with spots of delicate yellow down; these soon rub off, when the beetle appears to be of a shining black; it is sometimes of a reddish pitchy colour, whilst still immature. The wing-cases are united to each other, and the legs are generally bright chestnut colour.

I have not entered specially on this kind, for I am not aware of reports of its ravages having been sent me more than twice.

On June 6th, 1883, Prof. Allen Harker, of the Royal Agricultural College, Cirencester, forwarded specimens of this species (*O. tenebricosus*), which were then doing much harm by eating leaves of the Strawberries in the garden of the College Farm. The weevils were in such numbers that thirty of them were secured in a few minutes from their daytime shelter around the Strawberry roots. A female that was dissected contained eggs fully developed. (This kind is about the size of *O. picipes*, figured at p. 210.)

Also in the present year (1898) I received, from Gillingham, Dorset, on the 5th of May, a specimen of what proved to be *O. tenebricosus*, Herbst, with the observation:—"This is the third year in succession that the enclosed insect has attacked a young Pear tree growing against the brick gable of a house. It feeds on the leaves."

But however destructive our different kinds of *Otiorhynchi* may be, I can certainly say that the result of twenty years' communications appears to me to place *O. picipes* far ahead of the others as a pest to orchard, or to bush, or to ground fruit.

PREVENTION AND REMEDIES.—*The habit of the weevils of sheltering away from the light during the day is one great help towards keeping them in check.* They feed by night. By day they hide away, either buried in earth by the walls against which their food trees are trained, or underneath small clods round the stems of the trees on which they feed, or in rough bark; crevices where mortar has fallen out of old garden walls often swarm with them, and generally they shelter in any dark nook near at hand to their nightly resort.

Where the attack was bad enough to make it worth while to "sticky-band" the trees as for prevention of Winter Moth, this would be a good plan, as the weevils, being wingless, must travel on foot (this plan would, of course, not be of service for bush fruits such as Raspberries, *nor where the trees were fastened to walls*).

In such cases (looking at the habits of the weevil of hiding during the day in any crannies, or under clods of earth, stones, or rubbish), it would be very desirable to keep fruit-walls well pointed; also that all clods of earth, &c., should be cleared away that might serve as lurking-places. As they especially go down close to the wall, it might answer to run a line of ashes sprinkled with dilute paraffin, or with carbolic acid diluted in the proportion of one part of acid to a hundred of water, just along the junction of wall and ground.

A band of any kind of rough, cheap, cart or axle grease, run along the lowest part of the wall, would isolate it from attack, if the trees were also properly sticky-banded.

In the case of attack on Strawberry plants, and on the larger scale of plantation fruit-growing, it would be easy to find what kind of shelter the weevils preferred; and by placing some of this, whether slates, tiles, odd bits of thin turf, or *morsels of old waste sacking*, on the ground by the stems of the young trees, these would probably form excellent traps, which might be cleared daily with little trouble.

The best method of *remedy* is based on the habit of the weevils of dropping down off the bushes on any disturbance when feeding at night, or if a light is flashed on them.

In the observations taken at the Royal Agricultural College, Cirencester (see p. 214), with regard to the bad attack on Strawberry plants, a temporary shelter, such as pieces of boards, or tiles, was laid along by the plants, and on raising these, the weevils were found collected in such numbers beneath that nothing further was needed to clear them out excepting sending a boy round regularly to gather them up and destroy them.

Where the infested plants are of a nature of growth, or are trained in such a way as to admit of the weevils being shaken off (when they have gone up to feed at night) on to tarred boards or anything else placed below to catch them, this plan is the very best remedy of all. It is based on the habit of the weevils *of falling down at once on being disturbed*, or if a *light is flashed* on them. Details of this plan as carried out on a large scale with great success on Raspberry grounds in Cornwall will be found at p. 212; but it must be remembered that the jarring of the bush should be precisely at the time when the light is flashed on it, or in all probability the weevils will be found to have dropped down when the light was thrown on them and secured themselves, and the subsequent jarring of the bushes over the tarred tray may produce no results.

On a small extent of ground the use of a common entomo-

logical sweeping-net has been found to answer for clearing bushes after dark.

The commonly adopted method of destroying these weevils in vineries and peach-houses is to spread cloths below the boughs, and shake the beetles down on them at night; then to gather the beetles together and destroy them with boiling water. This plan is equally applicable to standards, and, with a little management, to wall fruit trees; but it should be borne in mind that, as they drop when frightened, operations must not be begun until the cloths are placed ready.

It is recommended by Mr. Malcolm Dunn, of Dalkeith, that a white sheet should be laid under the boughs the day before, and a large and bright light used, so that when the beetles fall they may be easily noticed; otherwise, if no sheet has been spread and the light is dim, many of the beetles are almost certain to escape, from their colour being so like that of the ground.

Another method is for two people to hold a sheet below the boughs, and for a third to shake and then bring a light to catch the beetles by; but the above-mentioned plan is better.

Getting rid of the maggots is a most difficult task, but it was found by Mr. Malcolm Dunn that watering with a "strong solution of ammoniacal liquor and common agricultural salt is effective in preventing the increase of this pest."

Where the ground was empty, a scourging dressing of fresh gas-lime would probably clear the pests; but commonly they lie by their food-plants, which would be killed by such treatment.

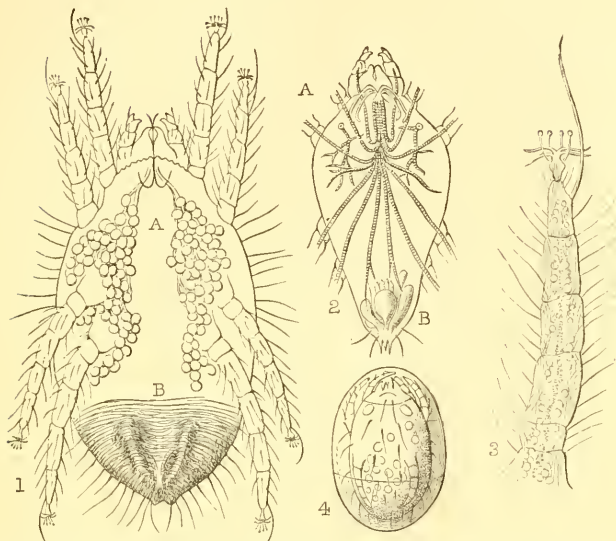
Skimming off the uppermost four inches of soil for about a foot in front of the walls on which the trees were infested would be worth trying as an experiment, to be carried out further if many maggots were found; by throwing some of the removed earth into a large tub of water it would be seen directly whether there were either maggots or beetles present.

Small plants may have their roots washed out, and thus be saved; but the ground on which they grow should be thoroughly dealt with at once. A full handful of fresh gas-lime put into each hole at once is a good cure for what evil may remain.

These pests should be looked to on their very first appearance, for, if once established, they are most difficult to get rid of.

RED SPIDER.

Red Spider. *Tetranychus (Acarus) telarius*, Linn.



TETRANYCHUS TELARIUS.—1. Female, showing, at A, the special glands of the silk-forming apparatus; at B, the striations of the genito-anal region. 2. Body of male; A, respiratory apparatus; B, reproductive apparatus. 3. One of the anterior legs, showing the setiform hair on the 6th article, the terminal hooks, and the four terminal cupuliferous hairs. 4. Hexapod larva in the egg, a little before hatching, with cross-line showing position of coming fracture of the egg. (Reduced from plate x. of 'Recherches pour servir à l'histoire des Tétranyques,' par A. L. Donnadieu.) Nat. dimensions given in letterpress.

The "Red Spider" is best known by the enormous amount of damage which in dry and hot seasons it causes to the leafage in our Hop grounds. But it is also to be found commonly and to such a serious amount on many other kinds of leafage, that, although it is *not an insect*, it may well be included amongst the injurious infestations of our orchard trees and fruit bushes.

This minute *Acarus* is *not* a true spider, but belongs to the division of *Arachnida* known as "Spinning Mites"; and the above figure of the foot, greatly magnified, shows the long stiff hairs, with globular formations at their extremities, which the Red Spiders make use of in arranging or in travelling amongst the webs which they form on the under side of leaves or the surface of bark, composed of threads so fine that they are scarcely perceptible without a strong magnifying-glass.

The egg is oval, or spherical, and colourless, and may be found amongst the webs on the leaves. The larva (as it is called, although the name is hardly appropriate, the "Red Spider" not being an insect) is stated to hatch in about eight days, and is much like the parent, excepting in having only three pairs of legs in early life, the fourth pair being acquired as it advances towards maturity.

The figure (4, p. 217) of the *Acarus* whilst still in the egg shows the two foremost pairs of legs pointing forwards; the single pair of hinder legs lying beneath the body of the "spider," and pointing backwards, and the eyes are also indicated by the roundish spots to the right and left of the fore part of the figure. Fig. 3, p. 217, shows the characteristic form of the terminal portion of the legs of the Tetranychii generally, as well as of *T. telarius*. This, it will be seen, is provided with two hooks, and each of these hooks is double and more or less bent, and ended by a point which is almost always very slender. At the base of the hooks, and at the extremity of the foot, are four stout hairs enlarged at the ends. This enlargement or caruncle has the shape of a small compressible sphere resembling a cupping-glass, and is of service to the "spider" in walking. The preceding division of the foot bears on the outside (see figure) one very long hair, which reaches far beyond the extremity of the foot.

The rostrum, which is placed in front of the body, forms a conical point of some size, the anterior portion of the body being advanced so as to protect the mouth-parts, of which fig. 1, p. 217, shows sufficient for common purposes; but the following extract regarding the palpi is of important interest in connection with the position and method of action of the spinning apparatus:—

"Underneath is the lower lip (*en gouttière*), and furnished with two large palpi, which form the most voluminous and the most projecting organs of the rostrum. These palpi, which are multi-articulate, have at their extremity conical spinules or hooks directed inwardly. They serve to direct the viscous matter, which, furnished by special glands, is expelled by the mouth. As it hardens in contact with the air it constitutes the threads of the web." — Donnadien, *op. cit.*, p. 138.*

* The above point of the position of the silk-secreting glands and the duct by which the thread is expelled is well deserving of attention from the various views which have been advanced on the subject, and especially from its being stated in Murray's 'Aptera' (the chiefly accessible work on Acarina to most English students), at p. 98, that "the threads of its web are secreted from a conical nipple situated underneath, and very near the extremity of the abdomen." The reader who wishes to go into the matter fully will find it entered on at pp. 96–98 of Donnadien's work referred to, from which much of the foregoing information is extracted. At p. 97 it is noted that "L. Dufour and Dugès

The "Red Spider" has difficulty in moving on perfectly smooth surfaces, but, by means of its claws and the pin-headed bristles with which they are furnished, it moves readily on the under side of the leaves, and fastens its threads to the hairs or slight prominences, thus gradually forming a coating of web, amongst which it lays its eggs, fastening them by some glutinous secretion to the threads; and under this shelter a colony, consisting of many of both sexes in maturity, and young in all their ages, feed and multiply with rapidity.

The colour is various, depending, as far as present observations show, on the colour and nature of the food within; possibly also in some degree on the age of the individual.

The attacked leaves may be known by their greyish or yellowish, somewhat marbled appearance above, whilst beneath they are whitish and shiny from the covering of web. This kind of Red Spider has been found sheltered, as if for the winter, beneath stones.

The above observations give as much of the general life-history and habits of the "Spinning Mites," commonly known with us as "Red Spiders," as is needed for practical purposes, without distinction of the different kinds of species that may possibly be present. But the following descriptions of *Tetranychus telarius*, translated from the works respectively of Donnadieu and of Berlese, special writers on the Tetranychy; and also from Donnadieu and Canestrini regarding a very similar and common kind known by the former of these two writers as *Tetranychus rubescens*, and by Canestrini as *T. telarius* of Dufour, are added, as probably serviceable for reference.

The following paper is extracted from the 'Recherches pour servir à l'histoire des Tétranyques,' par A. L. Donnadieu, Professeur au Lycée de Lyon, 1875 (p. 151) :—

"*Tetranychus telarius*, Donnadieu.

Acarus telarius, Linné.

Trombidium telarium, Hermann.

Tetranychus telarius, Dugès.

Trombidium tiliarium, Hermann.

Flexipalpus tiliæ, Scheuten.

♂ *Leptus autumnalis*, Dugès.

attribute to the Tetranychy glands placed near the anus, and recognize in these creatures an anal spinning apparatus for the formation of their webs." Claparède noticed the glandular apparatus of some Tetranychy as being placed at the anterior part of the body, but was inaccurate in giving the excretory canals as opening through the palpi; and other writers have variously described the position of the glands and their excretory canals; but a reference to the page above quoted of Donnadieu's work, and reference to fig. 78 of his plate x., and of my reduced copy, fig. 1, p. 217, *ante*, will put the reader in possession of very full information on the subject.

“The most common, the best known, and the most frequently described of all the Tetranychî. To the general characters of all these *Acarina* it unites the following special characteristics :—Rostrum conical, obtuse ; palpi very strong, and very well armed, fine hairs, acicular, long, and strong ; ligules well toothed. The feet armed with strong and recurved claws. The body ovoid, of a greenish brown, covered with long and numerous hairs, all of these setiform. Around the median stigmata four long thick cylindrical hairs, twice recurved, two of them directed forward and two backwards. Feet and rostrum pale yellow. The body convex above and in front. The male small, elongated, pale yellow, transparent, the feet long and strong, much stronger in proportion than those of the female.

“It is the male which, taken to be of a peculiar genus and species, was described under the name of *Leptus autumnalis*. Dugès has figured it under this name in his *Arachnida* of the large edition of the ‘Règne Animal.’

“The egg is globular, pale yellow, and gives birth to a larva of which the development is very rapid. The web produced by these creatures is very close. They work at it with great activity, and have soon covered large surfaces. They attack all kinds of plant-growths, and appear to delight in the Lime, in the localities where it exists. I have very often found them on plants with thin and flexible leaves, especially Kidney Beans and Campanulas.

“*Tetranychus telarius* is the species of which the synonymy appears the most easy to establish, or at least the least doubtful ; therefore we need not be surprised that Claparède has not in his work insisted on the specific characters. ‘There is no risk of difficulty,’ he observes, ‘in fixation of this species.’ It is the best accentuated type of all the spinning Tetranychî.

“It appears in the spring, develops rapidly during summer, and disappears a little before autumn. It is the species which is the longest lived. Length of the body of the female, one millimetre and three-tenths of a millimetre ; length of the body of the male, seven- to eight-tenths of a millimetre.”

The attention of the reader is particularly directed to the circumstance of the length of the male of the species described above being much less than that of the female, and the apparent differences being such that the male has been described and figured by Dugès as a distinct species under the name of *Leptus autumnalis*.

The following technical description of *T. telarius*, Linn., by Berlese, is given in the original Latin of the writer, as

being most desirable for scientific reference, but with a translation appended for general English use :—

Tetranychus telarius (L.), Dug.

(Berlese, A., Acari, Myriopoda et Scorpiones, fasc. lvi. No. 5 (1889.))

“*T. fuscus*, antico pedibusque roseis; pilis omnibus corporis exilibus, dermate plano (sive non verruculis pilos sustinentibus asperato). Mas pene runcato. Ad 600 μ fœm., 400 μ mas long.

“Habitat perfrequens æstate in plantis pluribus, in pagina foliorum inferiore, cum ovis, pullis, filis sericeis, folia occupans nec non ea punctura maculans, maribus non minus fœminis frequentibus.

“Obs. Color pedum, rostri et partis anterioris cephalo-thoracis albidus, roseo præcipue in pedum et rostri apice suffusus. Oculi sanguinei. Ceterum abdomen rufo-brunneo (cibo ingesto) infuscatum (tum etiam fusco viride). Sunt series in dorso longitudinales quatuor setarum, duæ mediæ duæque marginales. Setæ omnes nudæ, exiles, omnino pili-formes. Pedes setis longis ditissime ornati. Pedum unci quatuor inter sese æquales. Palpi longiusculi, præcipue in mari, tentaculo apice appendicula hyalina, cylindrica, minori aucti. Corpus ovatum supra convexum, transverse subimpressum, dermate ad setas in verrucas non elevato.

“Mas (2) fœmina corpore fere dimidio minor (quamvis pedes sint eadem magnitudine quam in fœmina) longe cordatus, postice acuminatus, pedibus anticis ceteris robustioribus. Palpi (3) articulo secundo superne gibboso et appendicula (a) corniculari acuti. Penis (6) runcatus, in extremo abdomine insitus. Color roseus, rufescens, pallidior quam in fœmina.

“Larva (9) hexapoda, globosa, curte setosa, rosea.”

Tetranychus telarius (L.), Dug.

“Dark brown, with the legs and anterior part rose-coloured; all the hairs of the body slender, the skin smooth (or not roughened by little warts carrying the hairs). Male with the penis shaped like a hook. Length up to six-tenths of a millimetre in the female, and to four-tenths in the male. Lives commonly during the summer on many plants on the under surface of the leaves, covering the leaves with its eggs, young, and silky threads, and sometimes spotting them with its punctures, the males being not less abundant than the females.

“Obs. Colour of the legs, rostrum, and anterior part of the cephalo-thorax whitish, suffused with rose, especially

towards the extremity of the legs and rostrum. Eyes sanguineous. Abdomen from reddish brown (with ingested food), varying to dark brown (sometimes also greenish brown). There are four rows of setæ—two median and two marginal—along the back, the setæ being all flexible, slender, and altogether hair-like. The legs very richly furnished with long setæ. The four claws of the legs all of the same size. Palpi rather long, especially in the male; the tentacle furnished at the apex with a small hyaline cylindrical appendage. Body ovate, convex above, somewhat impressed transversely, the skin not raised in warts at the setæ.

“Male with a body about half the size of that of the female (although the legs are of the same size as those of the female), of an elongated heart-shape, narrowed behind, with the anterior legs stouter than the others. Palpi with the second joint gibbous above, and [furnished] with a small sharp horn-like appendage. Penis hooked, placed at the extremity of the abdomen. Colour rose-red, paler than in the female. Larva hexapodous, globose, with short setæ, rose-coloured.”*

The following descriptions refer to another species of “Red Spider” (*Tetranychus*), recorded by Donnadieu as *Tetranychus rubescens*, by G. Canestrini as *T. telarius*, Duf.; but also possessing, like the preceding species, an extraordinary number of synonyms.†

This kind is noted by Donnadieu as rather common, and also that he has “very often found it on the Plum tree.” Canestrini mentions it as common on almost all plants, and as sometimes very injurious; and he also draws attention to the many names under which it has been described by different authors consequently on its “vast geographical distribution,” and the various natures of the localities which it frequents.

Tetranychus rubescens, Donnadieu.

Trombidium lapidum, Hermann.

Tetranychus cristatus, Dugès.

“Body entirely red, often very full coloured; the feet reddish yellow, slightly transparent, generally very large. The larvæ hexapod, as well as the males, of a slightly reddish tint, the feet pale yellow. The organic characteristics are very similar to those of the preceding (i.e. *T. telarius*, ante, p. 219). The body is enlarged and convex towards the anterior part. It

* Not being myself a thorough Latin scholar, I should perhaps mention that I submitted my translation for skilled examination, and offer it duly revised as above, with many thanks for the assistance kindly given.—E. A. O.

† As these will be found in the works to which references are given accompanying the description of the species, I do not append them here.

lives in societies of small numbers. The web is slight. The eggs are large. "I have very often found it on the Plum tree," on the Quince, on Petunias, &c. Rather common. Length of body one millimetre and a half."*

The following note is another description of the above species (*T. rubescens*) under the synonym of *Tetranychus telarius* of Dufour, as given by Canestrini in his work on Italian *Acarina*†:—

Tetranychus telarius, Duf.

"Body oval. Colour excessively variable—green, yellow, rose, red; usually there is a longitudinal central stripe along the back, which is of a brighter‡ colour than the rest of the body. The skin is delicately striated. The whole of the back is marked by four rows of rather long and slightly plumose bristles, the most frontal being the shortest. On the ventral side the skin is similar to that of the back, and bears simple bristles of moderate length and moderately numerous. The feet are lighter than the rest of the body, and bear rather longer bristles. Length, .40 mm.; breadth, .25 mm.

"Beneath the leaves of many plants; together with the adult forms, there are many eggs, in which the embryos are visible in all stages of their development. Besides these are hexapod larvæ and octopod nymphs. It is common on almost all plants, and sometimes causes much damage; for example, to Maize, Sorghum, and also to Vines.

"This *Acarus*, whether on account of its variety of colour, or its vast geographical distribution, being found on the most different kinds of plants, also in moss and beneath stones, has been described by authors under different names, which are to be considered as synonymous."—(G. C.)

The above technical descriptions are given in the hope that they may be of service where differentiation of the species referred to is needed; but for all practical purposes it will probably be sufficient to consider them, and to deal with them, as being what in this country we commonly know as "Red Spider."

PREVENTION AND REMEDY of *Red Spider attack on Plum or orchard trees or in gardens*.—The "Red Spider" is most

* 'Recherches pour servir à l'hist. des Tétranyques,' par A. L. Donnadieu, p. 152.

† See 'Prospetto dell' Acarofauna Italiana,' per Giovanni Canestrini, Prof. nella R. Università de Padova, vol. iv. p. 433. Appended to the above description is a synonymical list of about sixteen different appellations.

‡ "piu chiara," ? lighter or brighter.

injurious to vegetation in hot dry weather; and consequently washings and syringings, or drenchings by means of the garden-engine, which will render the leafage and ground, and the walls to which the trees may be attached, moist, will be very serviceable. The extreme dryness of air and soil are thus counteracted, and a healthy growth encouraged, which more or less counterbalances the injury to the leaves from the suction of the mites.

It is important to check the attack at the very beginning, and for this purpose syringings morning and evening are advised, sent hard at the under side of the leaves, so as to break the webs and wash them down with the contained mites, if possible, or at least do good by lodging something in them offensive to the mites.

Sulphur "is the active principle and most efficient agent" in preparations for destroying Red Spider, and sulphur and soft-soap combined in various ways are amongst the most reliable remedies.

Amongst the Hop-gardens in Kent "washing the plants with soft-soap and water, or even with pure water, is a remedy for the Red Spider, and some planters tried a *solution* of sulphur, thrown over the plants by the ordinary washing-engines in 1868, which killed these mites."

Looking at this point of sulphur being generally an ingredient in washes or applications for the destruction of Red Spider and other *Acari*, and the circumstance that in its crude state it does *not* combine with most of the fluids used for this purpose, may account for frequent failures in home-made applications. In order to make it combine with whatever liquid may be used, the sulphur should be boiled with an alkali, and the following recipe has been recommended: one pound of flour of sulphur and two pounds of fresh lime boiled together in four gallons of water; or, to save the trouble of boiling, the sulphuret of lime may be purchased and used thus:—Of this sulphuret take four ounces; soft-soap, two ounces to each gallon of hot water; the soap and sulphuret to be well mixed before the addition of the water, which is to be gradually poured on, the mixture being stirred during the time, when a uniform fluid will be obtained without sediment, which may be used when cool enough to bear the hand, and has been found to destroy insect-pests effectually and quickly. This may be used as a syringing, or a dip for infested shoots, or well rubbed with a brush into infested bark.

Gishurst compound is a good application, and sulphur in any form appears to act well. Probably the soap and sulphur compound sold by the Chiswick Soap Company, Chiswick, Middlesex, would be a thoroughly serviceable application.

Care should, however, be taken to raise the solution once to boiling point in mixing, and to test effects on leafage lest it should be used too strong.

The following recipe for dressing fruit walls answers well as a preventive of attack:—Having obtained some soot-water, tolerably clarified and as strong a solution as can be procured, this is worked up with clay till the whole is of the consistency of thick paint, and can be applied by a common painter's brush; to this, flour of sulphur and soft-soap are added in such proportion as may be preferred: one pound of sulphur and two ounces of soft-soap to the gallon has been found to answer. Every part of the wall is then painted with the mixture, care being taken to get it well behind the shoots, and also to paint a broad thick band along the bottom of the wall. This application, made once in the season as a regular yearly treatment, has been found to prevent Red Spider attack quite satisfactorily.—('Gardeners' Chronicle,' 1845.) This plan acts by poisoning and burying the "Red Spider" in the walls, and also by putting a band in the way of such as have been wintering under stones and rubbish, such as they will not care to cross to get at the tree; other mixtures, as preferred by the cultivator, might be similarly used.

Clean and properly pointed walls are a preventive of attack, as is also ground so cultivated and attended to that there shall be no neglected surface the mites can lurk in, or hiding-places under stones, clods of earth, or rubbish beneath which they can hibernate. An autumn dressing of gas-lime would be a desirable application to neglected borders where there are infested wall fruit trees.

In specimens of infestation of Red Spider ? sp., sent me in the autumn of 1880, from Lime trees near Walthamstow, the extent to which these mites spun their webs over the trunks and branches of the infested trees, so as to give a kind of glaze or silky appearance to the surface, was very noticeable. The eggs were to be found attached to the webs; and it has been found that brushing the tree-stems hard and thoroughly, so as to remove the webs, is serviceable in some degree in clearing attack, and would be still more so if some soft-soap was brushed in at the same time.

Amongst natural helpers against "Red Spider" infestation, it may be worth while to mention the "Minute Black Ladybird," the *Scymnus minimus* of Rossi, of which the maggots feed greedily on this pest. These little beetles, which I have reared from the larval condition, are very like the common *Coccinelle*, or Ladybird Beetles, in shape, but much smaller, being less than one-twelfth of an inch in length. The colour shining black; wing-cases pubescent and finely punctured;

legs testaceous, with darker thighs ; antennæ also testaceous, and lowest joint darker. The larvæ, when full-grown, were about the eighth of an inch or rather less in length, and remarkably active in their movements. The colour to the naked eye, smoky grey, when magnified, of a smoky yellow with black markings ; the head with some small black marks ; the three succeeding segments each marked with two black patches, the rest of the body marked lengthwise with six rows of black tubercular spots with bristles. With a higher power, the patches and spots are found to be formed of aggregations of little black dots, each collection bearing two or three or more white hairs, with here and there a few black hairs also.

On placing the maggots on some Plum leaves infested with "Red Spider," I found them shortly after busily feeding, and, failing other food, the maggots preyed on each other. The pupal change was gone through in the usual method of the Ladybirds—the larva suspending itself by the tip of the tail to a leaf. The pupa was of a shining black, and the change only occupied a few days.

A plentiful supply of specimens were sent me during August, 1893, by Mr. Edw. Goodwin, of Canon Court, near Maidstone, of which detailed notes are given in my 'Annual Report' for that year.

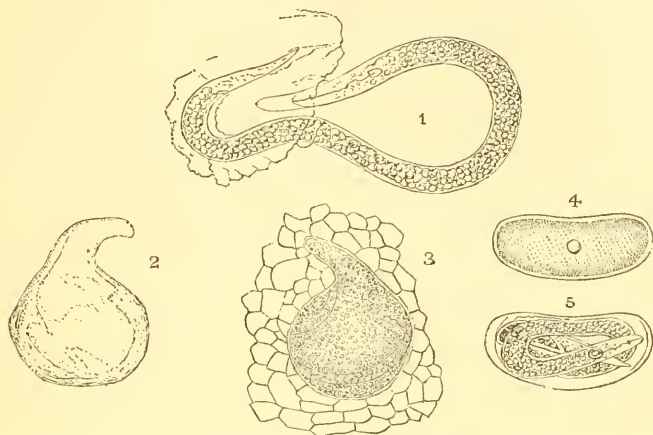
NOTE.—In the preceding pages I have only entered on the considerations of *Tetranychus telarius* as a general leafage pest. But it may not be out of place to mention that in the 'Praktische Insektenkunde' of Dr. E. L. Taschenberg this species is noted in his list of infestations of the Hop (pt. v. p. 224) ; and at p. 153 preceding, the species is noted as *Tetranychus (Acarus) telarius*, L.

Also in vol. i. of 'Insect Life,' p. 72, Prof. Riley remarks that he had been struck in his observations during the Hop harvest in Kent, in 1887, with the similarity in the general aspect of things both on the Hop and Plum in England and in America. . . . "and everywhere the omnipresent Red Spider (*Tetranychus telarius*)."

I have not myself had the opportunity of comparing it with authorized descriptions, but it is of interest to have the definite statements of the above well-known entomologists that respectively in England and America and in Germany they consider the "Red Spider" of the Hop to be *T. telarius*.

ROOT-KNOT EELWORM.

Root-knot Eelworm. *Anguillula radiculicola*; *Heterodera radiculicola*, Greef.; *Heterodera radiculicola*, Müller.



HETERODERA RADICULICOLA.—1, larva; 2 and 3, females; 4 and 5, eggs in different stages of development: all enormously magnified. (2 from sketch by E. A. O.; the other figures after Prof. Geo. Atkinson.)

Heterodera radiculicola is a small Eelworm which causes the growth of knots, or galls, on the roots of many kinds of plants, as those of the Tomato, Cucumber (under glass with us), Potato, Parsnip, Peach, Vine, Pear, Walnut, Lettuce, and many others where climate is suitable for development of this root scourge in the open air. These knobs are known as the root-knot disease, and according to the kind of plant, or the circumstances in which it grows, may be of the most various shapes and sizes, from a little knob perhaps not the twelfth of an inch across on Clover root, to large irregular masses of diseased growth, within which the "Root-knot" Eelworms are to be found, of both sexes, and in all stages, together with the eggs.

This infestation is to be found on the Continent of Europe, and in America, where it has been made the subject of careful investigation; but it was not until December in 1892 that observations of its presence in this country were sent me. In this case it was doing serious mischief by its gall formations on the roots of Tomatoes and Cucumbers; and though it is to be hoped that our climate will not suit this Eelworm as an orchard crop root infestation, still it has manifestly a power of

causing so much loss where it does establish itself, that a short description of the nature of the infestation may be of use.

Appearance of the galled roots.—The galls on the various kinds of plant roots on which I have seen them, that is, on roots of Tomato, Cucumber, and Lettuce, sent me for examination, were small knobs, or irregularly shaped lumps, varying in size from an eighth of an inch or less in diameter to (in the case of the Tomato) fleshy lumps a quarter of an inch to half an inch or more in width, and much more in length; even to as much as one, two, or over three inches of irregular swollen gall growth along the root fibres where the galls were confluent.

Taking a mass of roots on one of a number of good-sized Tomato plants, averaging an inch and a half or more in circumference a little above ground level, for special examination as a specimen of amount of gall presence, I found about twenty of the main roots were galled. These main roots as they branched and branched again, and even on the small side fibres, were infested with multitudes of irregularly shaped gall growths. Size as well as shape was quite irregular. Sometimes the “knots” were mere roundish fleshy lumps, about a quarter of an inch in diameter, but for the most part they ran wider, sometimes to half an inch or more in diameter, and very often ran to much greater length than this, consequent on the galls having joined, and thus forming a confluent mass along the root fibre. These formed diseased swollen growths of from one inch to two or three and a half inches along the root fibres, but rarely averaged more than half an inch, or a little more, in diameter.

When I first received the galled roots (sent me on the 19th of December), which had then been lying on a rubbish heap for about a month, the galls appeared to be firm and healthy, but soon many of them altered, in fact, fell to pieces, the bark peeling off, sometimes, according to circumstance, by drying, sometimes by wet decay, leaving merely the remains of the cells of which the gall had been composed, the harder parts of the tissue of the cells forming a little rough mass or lump on the root from which the outer coat had peeled away.

The enormous amount of Eelworm presence in the galls was enough to spread infestation in the earth, and to all plants near which were capable of receiving it.

The following notes of the life-history of this root pest are abridged from the excellently minute observations by Prof. Geo. F. Atkinson, referred to below.*

* ‘A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radiculicola* (Greef.), Müll., and the Injuries caused by it upon the roots of various plants.’ by Geo. F. Atkinson. Science Contributions from the Agricultural Experiment Station, Alabama, U.S.A., December, 1889.

The eggs of the Root-knot Eelworm (see magnified figures, p. 227) are stated to be oblong and bean-shaped, .08 mm. to .1 mm. long; the larva is coiled three or four times within the egg membrane, and when it comes out of the egg it is from .3 mm. to .4 mm. in length, and, like the adult male, it is thread-like in shape, and also, like it, has at the anterior extremity, in the opening of the gullet, a fine point on a trilobed base, known as the "exsertile spear."

The life-history is, that the young wormlets wander about for a time, then presently come to rest in the plant tissues, and undergo a change. The body of the larva, or wormlet, is stated to enlarge, excepting at the two ends, and forms a kind of "cyst," or chamber, in which the change of the Eelworm to the adult state takes place. *If this is to the male condition,* the wormlet in its chamber is stated to lengthen and become more slender and thread-like, until it is curled round several times within the chamber formed of its old larval skin; and when the change is complete, it breaks forth, roams in search of its very differently shaped mate, pairs, and dies. Its measure when full-grown is about one millimètre (the twenty-fifth of an inch) in length, and only the seventeen-thousandth of an inch at the middle, tapering to about half this width at the extremity at the head end, in which the œsophagus, or gullet, is placed, which is furnished at the foremost end with a minute needle-like point (sometimes known as a mouth-spear, E. A. O.), which can be thrust out and retracted, and rests on a trilobed base. *It will thus be observed that these male Root-knot Eelworms, from the time they quit the egg up to the perfectly developed condition, preserve the same thread-like, or fine eel-like, shape.*

But in the case of *the female* the transformations accompanying development are very different. The male, as noticed, moults and comes forth from the "cyst," or old skin in which it has advanced to maturity; but (still abridging from Prof. Atkinson's observations) it is noted:—"The female does not moult again, but continues to enlarge enormously until it is gourd-shaped" (see figures at p. 227). "About the time the 'cysts' have reached the stage when the male begins its transformations, it is easy to distinguish the female cyst. This continues to enlarge or 'swell' until the tail part is cast and thrust aside, and the body is sometimes so much swelled at the posterior end as to cause a noticeable depression at the opening of the vulva.

"Fertilization is stated to take place long before this gourd or pear-shaped cyst has ceased enlarging; this (that is, the female) continues to distend until in age its body is filled with eggs and young larvæ." And, "As the embryos are developing,

the body of the cyst breaks up into an amorphous gelatinous mass, in which the young larvæ and eggs are found floating within the cyst cavity. Length of life cycle, one month.”—(G. F. A.)

Method of spread of infestation.—The Eelworms may be found in all conditions in the root-galls. In the case of some specimens of galls from Cucumber roots which I forwarded to Dr. J. Ritzema Bos, the Director of the Phytopathological Laboratory at Amsterdam, for the benefit of his skilled opinion, he was good enough to tell me that he found the male and female and different stages of the larvæ of *Heterodera radiculicola* present, “like those in plate iv., figs. 9, 17, 18, 21, of Atkinson’s Report, and ova.”

The method of infestation may be in various ways. The Eelworms may escape into the earth through cracks in the gall, or may make their way out by use of their mouth-spear; or again, as I found in the case of the Tomato galls sent me late in the year (see p. 222), *may be freed in myriads* by the peeling off of the outer part of the coat of the “root-knot.” But in whatever way the Nematode may have conveyed itself *into the ground*, the next step, that of its entrance *into the plant* to be attacked, is thus described by Prof. Atkinson (p. 16 of pamphlet cited*) :—“Having escaped from its confinement, . . . it immediately selects another part of the root, or a fresh young rootlet, for attack, and places itself in position for the siege. Bringing into play its exsertile ram [mouth-spear], it forcibly gains entrance to the healthy tissues of the root,” &c.

In regard to the important point of attack *to rootlets* taking place from “Root-knot” Eelworms wandering free in the soil, it is thus recorded from his own observations by Dr. J. C. Neal† :—“I have found mature worms, males and non-pregnant females, in rootlets but a few days old, and under circumstances which involved the necessity of invasion from without the root.” These *Anquillulæ*, Dr. Neal notes, were small enough to enter the *stomata* of epidermal tissues, and he thinks it “not unreasonable to infer that in this manner they obtain entrance in young rootlets.” Once within they can make their way about in the tissues of the root, and the result of their presence is the unnatural development of cells, producing the irregular growth known as the gall or root-knot.

PREVENTION AND REMEDIES.—These at present appear, so far as I am aware, as a *certainly*, and at a paying (or indeed

* See footnote, p. 222.

† See ‘The Root-knot Disease of the Peach, Orange, and other plants, in Florida,’ by J. C. Neal, Ph.D., M.D., p. 12. Washington: Government Printing Office. 1889.

practicable) rate of outlay, to have eluded the most careful research. Some good it is considered may be done in special growing (as where one kind of crop can be kept thoroughly in hand, in limited space, or under glass, or in pots), by use of what are called trap-plants. That is, by sowing some small crop which is an object of attraction to the Eelworms, such especially as Lettuce ("Salat," *Lactuca sativa*), and keeping watch on these until it is found that galls are forming on the roots, then removing them, and destroying them with the contained pests. But in this treatment the utmost care must be taken in removal of the "trap-plants," for if they are *drawn* from the soil, however carefully, some of the galls, and with them the Eelworm tenants, will be likely to remain behind.

From his various records of observation Dr. Neal (in his work previously quoted) gives a summary of methods by which the disease can be easily introduced into areas not previously infested, which is a valuable practical guide as to points to be watched against. He mentions introduction may be "by means (1) of planting infested trees; (2), by the use of composts of muck and weeds from infested soils; (3), by the distributive action of water and air, the water carrying particles of soil and worms downward from an infested elevation, or by dry soil, fragments of dry roots"; and he also notes, "(4) soil containing these worms, I have no doubt, has been carried on the feet of men and animals, and deposited in healthy fields, forming the nucleus of a destructive agency, months afterwards made visible by its effects."—(J. C. N.)

To the above notes, taken from Dr. Neal's useful observations, should be added, in regard to the last item as to methods of transportation,—carriage in soil adhering to agricultural or garden implements, as ploughs, spades, forks, or trowels, or on wheels of carts or wheelbarrows. Also (most especially) care should be given in infested nurseries, or, in our country, in hothouses, or in growing of crops, such as Cucumbers, Melons, or Tomatoes under glass, that all earth in pots, or boxes, where infested plants have grown should be *burnt*, and the pots, or boxes, well scalded. *If the earth, or the galled roots, are merely thrown to the rubbish heap, there is no limit to the mischief that may be done; even by the carriage of the wormlets about the place on the feet or feathers of birds, cats, dogs, or other creatures.*

In the paper on this Nematode by Dr. J. Ritzema Bos,* he mentions that "the ground in which the Root Eelworms have

* 'Tierische Schädlinge und Nützlinge,' von Dr. J. Ritzema Bos, p. 781.

once been found, commonly remains infested agriculturally, and will only produce diseased plants"; and in a very bad case of infestation under glass which came under my own notice the expense of removal of infested soil, and carting in what it was hoped would remain clean, and also applications which it was hoped might poison the pest, have met with much less success than could be desired.—E. A. O.

The kinds of soil favourable for growth of root-knot appear to be those which unite lightness and dampness. In such soils the wormlets can travel with the most convenience to themselves when on their way through the earth to a new settlement, and they have also the moisture which is favourable to their vigorous growth. It is stated that "localities highly fertilized with composts, stable manure, or leaf-mould, show the root-knot quicker in plants than in compact or virgin soils, and the worst results are found in gardens planted in long cultivated, fully fertilized, and thoroughly pulverized areas. . . . A dry soil with solid growth is . . . unfavourable, hence, in many locations, drainage has entirely changed the character of the land, so that Peaches and Figs grow where they would not before."

Amongst the details of experiment made under the direction of the Entomologist of the United States Agricultural Department, and recorded by Dr. Neal, I do not find that any of the applications were thoroughly remedial. It is stated, however, that alkaline mixtures, 20 to 40 lb. to each tree, or caustic lime, kainite, muriate and sulphate of potash, or wood ashes, used several years in succession, have come nearest a cure, destroying no doubt many free worms, and inducing a vigorous tough growth of roots more difficult of penetration. But the very large amount of the fertilizer, "not less than 3000 lbs. to the acre," which is said to be requisite to produce the required effect, would entail in the case of many chemicals an expense not to be thought of.

In a series of experiments carefully carried out by one of my correspondents in England, who suffered severely from damage by *H. radicicola*, he tried the effects of the following chemicals, namely:—"Magnesium sulphate, iron sulphate, tartaric acid, lead acetate, citric acid, sodium sulphite, sodium hyposulphite, sodium caustic, potassium sulphite, potassium permanganate, potassium chloride, potassium ferrocyanide, potassium sulphide, potassium sulphate, potassium caustic, potassium acetate, carbolic acid, and potassium cyanide. Gas-lime (fresh), fresh caustic lime, and tobacco powder up to eight grammes."

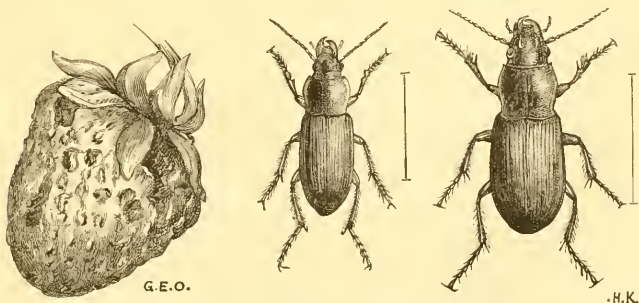
Full details of effect or non-effect of these on plant growth and Eelworm life are given in my 'Seventeenth Annual

Report,' pp. 99–108, and the proportion of the chemical to amount of soil is also given. Of these careful and repeated experiments the result was so far from encouraging that the experimenter's view is given as follows on p. 107:—"Therefore the only thing I can recommend is carbolic acid; . . . and I am afraid carbolic acid, although the cheapest remedy I have found, will be far too expensive for the Americans to use. Thirty-three ounces to fifteen cubic feet is equal to 6000 lb. to the acre, and would cost, for acid alone, about £75. Then, to be effectual, it should be thoroughly mixed with the soil with a fork: I am quite sure ploughing alone would not be sufficient. . . . I may add in using the carbolic acid I always mixed it with about twenty times its bulk of water, and then used a water-pot, with a fine rose, to sprinkle the soil, thoroughly mixing the soil afterwards."

I much regret that my correspondent declined to allow me to give his name except to special observers of this disease, but I may mention that he is one of our largest Tomato growers, and the great losses (up to tons of the fruit destroyed by the Eelworm) made it very important to him if it had been possible to remedy the evil. In his case the evidence pointed to the pest having been introduced on plants of *Dracæna* from the Continent of Europe.

STRAWBERRY.

Ground Beetles—"Bat Beetles." *Harpalus ruficornis*, Fab.; *Pterostichus* (*Omaseus*) *vulgaris*, Linn.; and other species.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, with lines showing natural length. Strawberry fruit gnawed by *H. ruficornis*.

In the year 1894 accounts were sent to me of much mischief caused by various species of "Ground Beetles" (duly identified at the time) to Strawberry fruit at Woodborough in Nottinghamshire. In this instance the farmer watched for the cause of the mischief, and detected the beetles swarming on the fruit by night, which they devoured to such an extent that the crop of three roods was ruined.

In 1895 the attack reappeared to a much more serious extent, for it showed itself at many places in the above district, and injured the Strawberry fruit to such an extent, just when it was beginning to ripen, as to cause severe losses.

In 1897, the specimen and reports forwarded showed this great trouble to Strawberry growers to be not only still present and injurious in the district where it was first observed, but also to be much more widely prevalent. In this county (Hertfordshire) the beetles appeared in great numbers in the early part of June at two localities, respectively, about two and a half miles in a north-easterly and two miles in a south-westerly direction from St. Albans, and also elsewhere in the district. In Norfolk they were reported in two localities. In Nottinghamshire they reappeared as again seriously mischievous. In Bedfordshire they were reported from one locality as a great trouble on a large acreage, with the remark that it was believed to be a general complaint. I had also information of the total destruction of a fruit-grower's crop near Tewkesbury, Gloucestershire, and similar destruction of three-quarters of an acre near Ringham, Berks. A glance at the position of the above-named localities on a map will show how widely this destructive visitation has spread since its first observation in 1894. Previous to that date, so far as I am aware, the attack of Ground Beetles to Strawberry fruit had not been noticed in this country; but in the summer of 1892 *Harpalus ruficornis* was identified by Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory, Amsterdam, as being found in great numbers in Strawberry beds in the neighbourhood of Goes, in Zeeland, Holland, and being very hurtful to the ripe fruit.*

The attack of 1894 was watched (so that there might be no uncertainty as to the cause of the mischief), and samples of the beetles taken proved, on identification, to be of three distinct species of *Geodephaga*, or "Ground Beetles," namely, *Harpalus ruficornis*, *Pterostichus* (= *Steropus*) *madidus*, and *Calathus cisteloides*.

* See 'Kurze Mitteilungen über Pflanzenkrankheiten und Beschädigungen in der Niederlanden in den Jahren 1892 und 1893,' von Dr. J. Ritzema Bos. Separate impression from 'Zeitschrift für Pflanzenkrankheiten,' iv. Band, 3 und 4 Heft. Also 'Biologisches Centralblatt,' xiii. Band, Nr. 7 und 8, pp. 255, 256.

In 1895, the Ground Beetles, of which specimens were sent to me as samples of the kinds destroying ripe and ripening Strawberries, proved, as before, to be of *Harpalus ruficornis* and *Pterostichus* (= *Steropus*) *madidus*, and, besides these, of *Pterostichus* (= *Omasus*) *vulgaris*. Judging by description, *Calathus cisteloides* was also present, but I did not receive specimens; and this being an important fruit matter, I not only identified the other three above-named species myself, but submitted specimens to an expert, who pronounced my identifications correct.

In 1897, the specimens of "Ground Beetles" sent me were once again *Harpalus ruficornis* and *Pterostichus* (= *Omasus*) *vulgaris*, which had appeared in 1895. These two species are very similar in shape, as figured magnified at p. 233.

Harpalus ruficornis is 6-7 lines long, pitch black, with the long horns and long legs usually red; the thorax is thickly punctured at the base, and the hinder angles acute; the wing-cases are faintly striated, and are thickly covered (whilst the specimens are fresh) with golden or greyish down. Beneath the wing-cases are ample wings, which they use freely for flight.

Pterostichus (= *Omasus*) *vulgaris* is rather larger than the foregoing, and is $6\frac{1}{2}$ - $7\frac{1}{2}$ lines, or possibly more, in length. Wholly black, and rather shining. Thorax rather broader than long, hinder angles bluntly pointed; wing-cases strongly and smoothly striated. No wings.

Pterostichus (= *Steropus*) *madidus* (figured accompanying) is from 6 to about 9 lines in length, and is black, though sometimes the legs have red thighs. The hinder corners of the thorax are rounded behind, so as to be narrower than the wing-cases. No wings.

Calathus cisteloides, Panzer, is a good deal smaller than the above-mentioned kinds, being from about 3-6 lines in length. Colour black, with horns and legs brownish red.

It is of the same general shape as the other "Ground Beetles," but distinguishable to some degree by the fore body being slightly narrowed in front, sinuated behind, and the hinder angles rounded off. Wings none, or imperfect.

The four above-mentioned kinds of beetles look very much alike, but a very little careful examination is enough to make out the difference clearly. *H. ruficornis* has ample wings, which may be seen by lifting the wing-cases, and unfolding the wings beneath with the help of the head of a small pin if no better instrument is at hand. The point is apt to tear



PTEROSTICHUS MADIDUS, magnified, and line showing natural length.

the delicate membrane. *P. madidus* is contracted into what may be called a "waist." *C. cisteloides* is commonly much smaller than the other three kinds; and *P. vulgaris*, which has a strong general resemblance to *H. ruficornis*, is easily distinguishable by this (*vulgaris*) being wingless, whilst *ruficornis* is winged.

The so-called "Ground Beetles," *Geodephaga* scientifically (the sub-section to which the above-named Strawberry destroyers belong), were formerly supposed to be almost entirely of carnivorous habits, and we are indebted in a great degree to the researches of Prof. Forbes, U.S.A., for information as to the nature and proportion of vegetable food to be found on dissection in many kinds of this predacious division.*

In 1898, the Ground Beetles again appeared, and gave opportunities of some successful observations of prevention and remedies recorded under this heading.

Of the *Geodephaga* it is noted by Mr. Rye that "superficially they may be known by their active habits, slaughtering propensities, thin legs and antennæ, and hard outer covering. . . . The larvæ of the *Geodephaga* are little known; they are, however, mostly found in the same places as the perfect insects. A geodephagous larva is usually flat, elongate, parallel-sided, fleshy, with the head and first segment hard; the eyes are rudimentary, usually being compounded of six small ocelli grouped together; the legs are horny, six in number, and situated on the first three segments; there are short jointed antennæ and palpi, and powerful sickle-shaped jaws, and the apex of the body has usually two horny or fleshy appendages on its upper surface, the lower part being lengthened into a membranous supplemental leg."—(E. C. R.)†

The first observations sent to myself of what may be called "straightforward" crop feeding habits of any of the above four kinds of beetles were sent in 1885, when specimens of *Pterostichus* (= *Steropus*) *madidus*, taken in the act of preying on young Mangolds very early in the morning, together with specimens of the Mangolds eaten through by the beetles a little below the crown, were sent me from near Bishops Stortford.

No further observations of serious damage from Ground Beetles were forwarded until 1894, when inquiries were for the first time sent me regarding their attacks on Strawberries by Mr. M. R. J. Dunstan, M.A., Director of Technical Instruction for the County Council of Nottinghamshire. The species identified were *P. madidus*, *H. ruficornis*, and *C. cisteloides*,

* See 'Twelfth Report of the State Entomologist of Illinois, U.S.A.,' 1882, pp. 105-116.

† 'British Beetles,' by E. C. Rye, pp. 44 and 46.

above described. Regarding these it was noted that "the actual berries were attacked and devoured by the beetles at night, who swarmed on the plants, and the crop was of course ruined. The attack was watched by the farmer, who had three roods devoted to Strawberries, and the beetles themselves seen to be the actual culprits feeding on the berries." This appearance was at Woodborough, in Nottinghamshire, and, as will be observed, was only on a small area.

In the next year, 1895, the attack reappeared to a serious extent in the Woodborough district, and the following extracts from observations sent give some idea of the method of attack of the beetles and the amount of injury.*

The first information sent me was on the 23rd of June, from Woodborough, that the beetles were "eating the fruit fearfully. . . . We think the pest is worse than last year, and others are suffering quite as much as we are at this present time."

On July 2nd it was reported that though in the previous year the attack had only been on the one crop mentioned above, yet now in many places the district swarmed with them, and the attack began when the fruit was full-sized, and within three days of ripening. As an instance of the damage being done, it was mentioned that part of a field planted with Strawberries was valued at £10 as they were, but a few days after were so ruined that the crop only fetched thirteen or fourteen shillings; and the mass of the other plantings were left an utter wreck, the whole crop being marked by the beetles.

Regarding the method of attack, it was noted that "the beetles lie round the plant and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter; the opening being through the litter and just under the bunch of fruit attacked. The beetles are without number, and seem most active an hour after dark, being full and dormant at break of day, and much deeper in the soil. The green fruit is really cleared of its skin, and many of the seeds left. . . . The green Strawberries dry up and wither after an attack, while those riper turn moist and soon rot." It was also observed that in the case of the riper fruit the seeds were especially attacked, "and lay under the berries as thickly as hail."

In 1897 similar descriptions of method of ravage were sent from widely separated localities. From a garden near St.

* For detailed observations with names of contributors appended, see my Nineteenth Annual Report. The beetles identified as injurious were once again *Harpalus ruficornis* and *Pterostichus* (= *Steropus*) *madidus*, and also *Pterostichus* (= *Omasus*) *vulgaris*. Judging by description, the smaller kind, *Calathus cisteloides*, was also again present, but specimens were not sent me.—E. A. O.

Albans it was mentioned that about the middle of June the beetles were noticed in great numbers on and about the Strawberry bed; "they remained in the soil during the day, and came to the surface at night. They first attacked the Strawberry beds when a few berries were ripe, and then turned their attention to all the berries, whether green or ripe. The whole crop, an exceptionally good one, was destroyed in less than a week. After they had done all the mischief they could, they disappeared, but a few are still to be found in the soil at the date of this letter" (Sept. 20th, 1897).

Another correspondent, writing from Walsingham, Norfolk, with specimens of injured Strawberries and of *Harpalus ruficornis* accompanying, mentioned that he had a most splendid show of fruit, and now he found that nearly all the berries were like those forwarded, and that there was not a Strawberry on the bed worth eating. On searching in a crack in the ground in the Strawberry bed, about a dozen of the beetles, nine or ten of which proved to be *H. ruficornis*, were found in about twelve or eighteen inches. The ground in many places was covered with a powdery deposit, which proved to be of seeds eaten off the berries.

Other reports from various localities gave observations of serious damage to the Strawberries from the "Ground Beetles" eating the surface of the fruit from the time of it beginning to swell until it was ripe, the information in these being so similar to the notes quoted above that it is unnecessary to repeat them *in extenso*; but the following observation, referring to the nocturnal nature of the operations of the beetle, is of some special interest. In this case about three-quarters of an acre of Strawberries had all been spoilt for sale by beetles, which proved, from samples sent, to be *Harpalus ruficornis*, and it was noted: "They were not to be seen on the surface in the daytime, apparently burying themselves about an inch under ground, but at night they were very busy."

The greater prevalence of this kind is worth notice in connection with it not only having ample wings, but also the disposition to use them for transportation of the insects *in flights of considerable numbers together*. I am not aware of observations of this habit having been recorded until the summer of 1897, when, on the 14th of June, a number of specimens were brought over to me by a neighbour from Bone Hill, near St. Albans, which proved on examination to be *Harpalus ruficornis*, as part of such a very numerous appearance that it was described as a swarm, of which so many fell at 10 p.m. the previous evening on members of the family sitting in front of the house, that it was supposed the

beetles were tumbling from the roof. Also at Sandridge Vicarage, about five miles from the above locality, where the Strawberries were much injured by Ground Beetles, they were noticed early in June by scores falling from the walls of the house, having apparently struck the wall in their flight and then fallen to the ground.

Besides the above broad-scale observations of the habits of the beetles, I took the opportunity of the numbers of specimens sent me for special observations. *The first series* were carried on by putting a number of *H. ruficornis* beetles in a glass jar with some ripe Strawberries, and for seventeen days, that is, from the 4th to the 21st of July, I continued my observations daily of the attacks of the *ruficornis* on the fruit. No other material which could be used as food was given to the beetles, and I usually renewed the Strawberries every evening, taking care to examine each berry before placing it in the jar, so as to be sure there was no other insect infestation.

The result of my observations (usually taken in the morning) was that the beetle injury to the fruit was of various kinds. Sometimes little pits about the eighth of an inch across were hollowed out, or these pits might be more or less confluent with the surface of the berry damaged between them so as to form a patch half an inch long. In another berry a quarter of the surface would be gnawed; in another much of the outside of the fruit was ruined by the beetle-gnawings, which gave a slimy mashed-up appearance to the fruit, and (speaking generally) from removal of seeds and roughening of portions of the surface, even where worse damage was not done, the selling value of a crop so treated would have been spoilt. The beetles appeared to continue in perfectly healthy condition, and on the fifteenth and sixteenth days of their captivity were pairing; and after the seventeenth day, as I had found they could live well on Strawberries without any other food, I discontinued the special observation.

With a view of ascertaining that fruit-feeding was not a peculiarity, an idiosyncrasy, so to say, of special beetles, but that the identical beetles feed equally willingly on Strawberries or on meat, I placed about a couple of dozen beetles sent me as Strawberry-feeders, of which some were *Pterostichus vulgaris*, but the greater part *Harpalus ruficornis*, in captivity, and varied their food for some days. The result showed that their bill of fare included not only Strawberries, but live worms, uncooked mutton, cooked meat and fish, and bread. They did not, however, prey on each other, though they attacked the soft parts of a *Sirex gigas* which was still fresh.

PREVENTION AND REMEDIES.—The above observations are given in such lengthened detail in the hope that they may afford some clue towards more complete methods of dealing with this destructive and (at present) increasingly prevalent attack than we possess at present.

The great point to be noticed in the habits of the beetles is that they *feed by night*; after their nocturnal ravages, they shelter, it may be, in cracks in the ground, as noted by one observer; or again, in the way noted at p. 237:—"The beetles lie round the plant, and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter; the opening being through the litter and just under the bunch of fruit attacked. The beetles . . . seem most active an hour after dark."

In one of the reports sent me it was mentioned that "flesh covered by pieces of thick sacking attracts a number which are easily killed." It was also noted that the beetles had been caught by vessels being baited and set in the ground, into which the beetles fell, and could be killed by some destructive mixture. Also a note sent on July 24th, 1895, mentioned that "A well just dug has the surface of the water entirely covered with the beetles."

But it was not until the 19th of July of the year 1898 that, through kind courtesy of Messrs. Laxton Brothers, of Bedford, I was favoured with information of a method of treatment which they had found quite successful for clearing the pests out of their own beds, and which they permit me to publish, with their name attached.

Messrs. Laxton wrote as follows:—

"We are pleased to be able to report that we have almost entirely destroyed the beetle pest which played such havoc with our Strawberry crop last season.

"We purchased a large quantity of cheap pudding-basins, early this spring; these are let into the ground, level with the surface, at distances of a few yards apart, and kept them baited with pieces of lights and sugar-water. When the weather was dry we often caught half a basinful of a night, until the number gradually diminished to two or three, and now none at all. It is a laborious process, but well worth the trouble, as we have lost no fruit this season.—(Signed) Laxton Brothers."

Another method which, if too expensive for broad-scale growing, answered excellently on the smaller scale of a private garden, was mentioned to me by my friend and neighbour, the Rev. J. A. Cruickshank, as having answered thoroughly in saving his Strawberries in the Vicarage garden at Sandridge, near St. Albans, from the *Harpalus ruficornis*,

which had done much mischief there last year, and had again appeared.

The ground amongst the Strawberries was covered, as is customary, with straw, and the plan adopted by the gardener was to remove the straw from a space, and then, trowel in hand, turn over the surface of the ground temporarily laid bare, and secure the sheltering beetles. Thus, gradually going in this way through the bed, the beetles were captured by hundreds, and—whereas the first part of the crop was ruined,—afterwards (when the plan was carried out) the fruit was saved from further ravage.

The above observations, and especially that of Messrs. Laxton, as being practicable in *broad-scale* growing, seem to me a great advance towards stopping the very *broad-scale* ravage which we have been suffering from.

Experiment as to possibility of poisoning the beetles by a mixture of red lead made up into a paste with flour wholly failed. Of this it was reported:—"Red lead has no effect upon the beetles. I mixed flour, dripping, and the lead into a paste, and gave it to some in a box; they at once devoured it greedily. That was on Saturday. This morning (Monday) they are as lively as ever."—(T. E. P.)

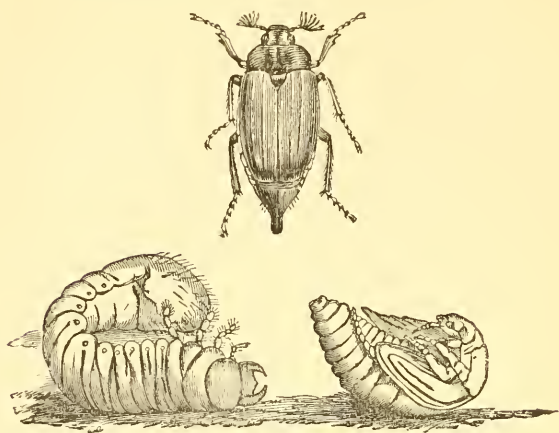
As three of the four kinds of beetles specially observed as Strawberry destroyers are wingless, it appears plain that the infestation of these must either be nursed up in the Strawberry beds, or be brought in manure; and as the *Harpalus ruficornis*, which I kept under observation, were pairing on the 19th and 20th of July, it is presumable that the other kinds would also be pairing about the same time, and the young grubs soon hatching and feeding on animal matter, as worms and the like, in the earth of the Strawberry beds.

Whether, when the beds are dressed, a strong application of kainite, which is injurious to development of some larvæ, would help in this case might be worth trial.

Opinions appear to differ as to serviceableness of moles; from the wing-cases of the beetles being found in the rejectamenta of the moles, there appears to be no doubt that they devour the beetles, if so disposed; but there is no mass of evidence as to benefit from their presence.

Detailed information from which the above notes are chiefly taken will be found in my Eighteenth, Nineteenth, and Twenty-first Annual Reports on Injurious Insects.

Cockchafer. *Melolontha vulgaris*, Fab.



MELOLONTHA VULGARIS.—Common Cockchafer, maggot, and pupa.

The Cockchafer is very injurious both in grub and beetle state. In the perfect condition, that is, as Cockchafer beetle, it preys to some degree on conifers, especially on Larch shoots and leafage; but none of our common deciduous forest trees, whether Oak, Beech, Maple, Horse-chestnut, or other kinds, appear safe from its attacks, even to the extent at times of stripping them of their foliage. Amongst orchard trees Apple, Plum, Cherry, and Nuts are kinds particularly liable to infestation.

The grubs feed voraciously below ground on many kinds of roots. In pasture land their ravages at the grass-roots are a very severe trouble; and they also feed at the roots of young trees in nurseries, and do much damage at times to young Fir roots; notes have been sent me of injury to thousands of seedling Fir only about ten to twelve inches high by the grubs removing the bark in large patches from the main roots. They will also feed on field crop roots, such as those of Mangold, Potato, and Turnip; and (relatively to the present considerations) their injury to Strawberry roots are recorded on the Continent as one of the regular attacks; and complaint of it has been sent to myself of this even in the present year. The infestation is to be found not only from the South of England to the North of Scotland as far as Aberdeen, but even in the island of Orkney.

The Cockchafer beetle is almost too well known to require description; but it may just be mentioned that it is of the

shape figured above, an inch or somewhat more in length, densely covered with down on the breast and more or less throughout. The fore body black, or sometimes reddish brown. Wing-cases and legs red-brown; the former with five smooth longitudinal ridges, the depressions between them being covered with whitish scales. Abdomen black, with triangular patches of white hairs or scales on each side, and tapering into an elongated extremity. The antennæ short, and with the fan or club of six leaves in the female; but longer, and of seven leaves, in the case of the male. Beneath the elytra or wing-cases the beetles have large and powerful wings; and in May they may be found hanging half torpid or sluggish beneath the leaves during the day, and coming out on the wing during the evening, when they fly in search of their mates or feed on the foliage of the trees.

The females very soon after pairing lay their eggs at a depth variously stated as from two to four or about six to eight inches below the surface of the ground, this point very likely depending a good deal on the nature of the soil. The eggs are roundish in shape, and whitish or yellowish in colour, and are laid in considerable numbers up to as many as eighty or more in a heap or heaps in the disturbed ground.

The maggots or larvæ may be generally described as large, fleshy grubs (see fig., p. 242), and whitish or yellowish in colour, with the tip of the abdomen of a violet or bluish tint from the excrement showing through the skin; with strong jaws, three pairs of reddish legs, and usually lying on one side somewhat curved together in the ground. I add the description by the Rev. Canon W. W. Fowler as being serviceable for technical reference:—

“The larva of *Melolontha vulgaris*, the Common Cockchafer, has been described by many authors. It is large, thick, and fleshy, of a dirty white colour, with the head ferruginous and shining, and the legs pale ferruginous; the antennæ are a little longer than the mandibles, and are 4-jointed: the anterior pairs of legs are rather shorter than the intermediate and posterior pairs, which are of equal length; the segments are transversely rugose, and the last is large and apparently divided by a false articulation; the upper surface of the body is furnished with short upright bristles, and long separate hairs which are intermingled with these. The pupa is rather large, with the abdominal portion slightly curved, but does not present any striking peculiarities.”*

For distinction between the larva of *M. vulgaris* and *Phyllopertha horticola*, see *ante*, p. 31.

* ‘British Coleoptera,’ Fowler, vol. iv. p. 51.

The life-history appears to be that the eggs hatch in about a fortnight, and the grubs which hatch from these attack the roots of grass, &c., as mentioned above. It has been said that in the first season after hatching the grubs feed not on roots, but on "humus"; but whether this is customarily the case I have not had personal opportunity of investigating; they feed during the warm part of the season for three or more years, going down in winter to a greater or less depth according to circumstances; and at the end of the third or fourth summer go down to a depth *stated* to be two feet or more. Here they change to the perfect state, the Cockchafer making their appearance early in the following summer.

The lowest depths by measurement from which Cockchafer grubs have been sent me were five to six inches below the surface. They had not been further down, because they were always found at the bottom of their burrow. This was at the beginning of the month of February, and the readings of a minimum thermometer in the neighbourhood showed (approximately) that they were not injured by cold reading down to 18° (*air temperature*), as long as they remained in their own shelters; but when turned up to the surface a fortnight or so after, that then they had not sufficient vitality to burrow down again into the ground to shelter themselves anew.

PREVENTION AND REMEDIES.—Cockchafer attack is difficult to deal with under any circumstances of common amount of infestation; but in connection with Strawberry growing hardly any measures appear to be directly practicable. *Shaking down and destroying the beetles*, where they are observed in great numbers on trees near Strawberry beds, would probably be of some service. This should be done, during the day, whilst the beetles are clinging beneath the leaves, and are dull and sluggish, before they take their evening flights. They may be shaken down on to large cloths spread beneath the trees or may be swept together, taking care that in either case the Chafers are collected together and destroyed before they have time to recover from the fall and to take wing. If they are shaken on to the ground many may be secured by having pigs (which will eat the beetles greedily) at hand, to take them as they fall; and poultry are also useful; or, in the absence of these, probably having some boys to trample on the shaken-down beetles and collect them at so much a quart would ensure a large proportion being killed.

Another method of collecting is as follows:—"The workers are provided with narrow-necked glazed vessels, or sacks, in the opening of which the broken neck of a beer-bottle has

been fastened to serve as a funnel through which the beetles may be dropped.”*

In the work above quoted mention is made of sods of grass being serviceably used for trapping; these, it is mentioned, are cut eight to ten inches broad and six to eight inches thick, and were laid on the surface of the ground, with the grass downwards, in the forest of Allstadt, Weimar, in the autumn of 1870; and from three to eleven larvæ were found under each sod in July, 1871. Thus, in a short time, 16,000 larvæ were collected. (See p. 182 of work quoted.)

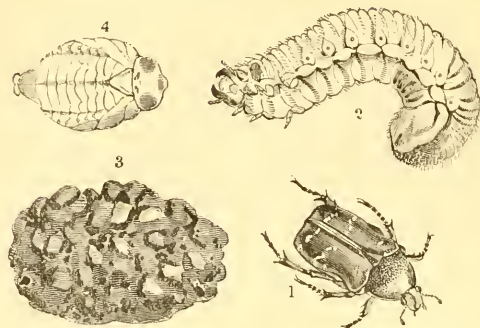
Likewise (same page), as traps for larvæ, mention is made of “Rolls of bark filled with loose soil and placed in the ground.” Also, of “Heaps of turf, weeds, humus, burned sods, and dung, &c.” “Such heaps,” it is observed, “afford looseness, dryness, warmth, and nourishment for the larval development.”

It is, however, exceedingly unlikely that where, as with us, Cockchafer attack is of rare occurrence to a severe extent, that *preventive* measures will be carried out or would be generally worth while; and when the grubs are found working at the Strawberry roots, disturbing the plants to get at them might do more harm than good.

Wild birds, such as Rooks and Sea Gulls, should on no account be driven off. The Black-headed Gull will follow the plough in the same manner as the Rooks, and feeds on Cockchafers both in the grub and beetle stages; and the Common Gull will go for miles inland to follow the plough in search of grubs and insects. Where some of the above large birds can be kept tame, they do good service by getting at the grubs without the harmful disturbance caused by stirring the soil round the Strawberry roots.

Various deterrent applications might be worth trying, as, for instances, dressings of soot to make the surface of the ground obnoxious to the beetles at egg-laying time; also (see *ante*, p. 35), heavy top dressings of kainite and nitrate of soda have been found beneficial on infested grass-land. But in the case of Strawberry beds which have become infested a treatment which would clear the grubs without risking still worse damage to the plants does not appear as yet to be known.

* See Dr. Schlich's 'Manual of Forestry,' vol. iv.: "Forest Protection," by W. R. Fisher (p. 183). London: Bradbury, Agnew & Co., Bouverie St. 1895.

Golden Chafer or Green Rose Chafer. *Cetonia aurata*, Linn.

CETONIA AURATA.—1, beetle; 2, larva; 3, cocoon; 4, pupa, showing back.

The Golden Chafer, like the Cockchafer mentioned in the preceding paper, is injurious both in larval and perfect state. As a beetle it frequents many kinds of flowers, including those of the Apple, and of the Rose, from which it takes one of its names; but it is more especially injurious in its attacks to Strawberry blossom, and to the flowers of Turnips left for seed, where it eats off the anthers from the stamens, and thus renders the flowers abortive. As a maggot it feeds on roots of grass and other plants, and was considered by Curtis as in all probability sometimes to cause much mischief by feeding at the roots of Strawberries.

The beetle (figured above, life size) is of a bright metallic green or golden green above; coppery, with a rose tint, below; the wing-cases are punctate, and marked with spots or streaks of white or ochreous colour, so placed as often to look like cracks across the metallic green of the wing-case. The horns are ended by a club much like that of the Cockchafer (see figure, p. 242), excepting that it has only three leaves or plates, whereas that of the Cockchafer has seven plates in the male, and six in the female. The wings are large and membranous, of a brownish colour, with horny veins; and when the beetles are seen in flight on a sunny day they are very conspicuous objects, and (if quietly watched) noticeable for the care with which they will choose a place (presumably) for egg-laying, by floating round in the air till an available crack in the ground is selected, and then with good aim sweeping down into it and disappearing.

The Chafers lay their eggs *in the ground*, including in this such places as heaps of rich earth, and Cucumber beds, in

gardens, and the maggots feed on roots, as of grass, &c., and conjecturally also on decayed matter, as they are found in the decayed wood-soil which accumulates within old hollow trees. When full-grown the maggots are upwards of an inch and a half in length, thick and fleshy, of a whitish colour, with an ochreous head armed with strong jaws; the three pairs of *short feet* are of a rusty ochreous colour, and the hinder portion of the grub or maggot is enlarged, curved towards the head, and of a lead colour. These grubs are much like those of the Cockchafer; but, amongst other points, are distinguished (as mentioned by John Curtis) by being covered with transverse rows of short hairs, and also by the *feet being pointed*, whereas the feet of the Cockchafer grubs are blunt and rather dilated at the tips (a comparison of the figure, p. 242, with that at p. 246 will show the different appearance).

The grubs are considered to live underground for two or three years, and when full-fed they make earth-cases "as large as a walnut," at a considerable depth beneath the surface, which are smooth inside, but covered outside with pellets of soil which have passed through their own bodies (in an instance specially watched, this was noticed to take place in the second week in June). In these earth-cocoons they turn to ochre-coloured pupæ. The figure, p. 246, shows the appearance of the back of one of the pupæ (the legs and wings being folded beneath so that only just the base of the wings at the insertion of the thorax shows).

The beetles appear early in the summer, and on a sunny day look exceedingly beautiful from their golden metallic gleam as they fly about with the help of their large membranous wings, and thus, if the weather be fine, they contrive to do a deal of mischief during the summer by passing from one crop to another. In wet weather they die earlier in the season.

In the neighbourhood of Isleworth, where Strawberries are grown in fields of many acres to supply the London market, I have had the beetles brought me in great numbers, and to a greater or lesser extent they are a very common infestation; but the following note, sent me on the 25th of May (1895) by Mr. Leonard Micklem, from Yardley House, Chingford, Essex, records such an unusually numerous appearance of this beetle that it is worth special notice:—

"I am sending you by post three specimens of a green beetle which is becoming an insupportable pest in my garden, in the hope you may be able to suggest some method of eradicating it. The beetle appears annually with the Apple blossoms, which it devours greedily, and is now paying

attention to Medlar and Iris bloom. My gardener has killed more than 2000 already this season, but even this appears to effect no diminution in their numbers."

A few days later Mr. Micklem, writing further regarding the Golden Chafer attack, remarked that the capture that day was 373, "and this in spite of daily destruction since their first appearance."

The fullest account that I am acquainted with of this Golden Chafer as a Strawberry blossom pest is that given by John Curtis in the 'Gardeners' Chronicle' (1841, p. 452) relatively to the partial or total failures of Strawberry crops in different parts of the country in that year, which he considered were undoubtedly in part owing to the ravages of the *Cetonia aurata*. I extract the passage (duly acknowledged) below:—

"From its nestling and reposing in the flowers of the Rose it is generally called the Rose Chafer, but it is also attached to the Whitethorn, Candytuft, Elder, Mountain Ash, Peony, and Strawberry, the flowers of which it feeds upon, and the latter were attacked this year" [1841, E. A. O.] "at the earliest period I ever remember, for on the 11th of May the Rose Chafers were in such prodigious numbers on the flowers and leaves that it became necessary in some gardens to have them collected and killed.

"The beetles generally destroy the anthers, eating them off with great dexterity, probably to revel upon the honey secreted in the nectary, so that by their agency immense quantities of Strawberry flowers are rendered abortive; when one crop has flowered they take their flight to another."— ("Ruricola" = John Curtis.)

PREVENTION AND REMEDIES.—The beetles are so large and so sluggish in dull weather that there is then no difficulty in taking them by hand; during sunshine they may be taken with a bag-net, and destroyed in any way that may be most convenient.

Where the maggots are numerous, they should be got rid of by turning over the soil, or by spreading neglected heaps of rich earth, old Cucumber beds, and similar places which they frequent, and hand-picking all that are seen. Poultry will help very much in clearing the grubs, if driven in whilst the ground is being turned over.

Where the attack is on the roots of growing plants (in enclosed places), it will be found serviceable to have a few tame rooks or sea gulls in the garden, as they can dig down with their bills amongst the roots which could not otherwise be meddled with, and clear large numbers of the grubs without harming the plants.

From the circumstance of the maggots being sometimes found in the decayed wood-soil that accumulates within old hollow trees, it would appear desirable to remove all wood rubbish, and also heaps of decaying sawdust, that may attract the beetles or shelter the grubs.

For other remedies, see "Cockchafer," p. 245.

Strawberry-leaf Beetle. *Galeruca tenella*, Linn.

The *Galeruca* (or, as it has recently been called, *Galerucella*) *tenella*, is a very little beetle, only an eighth of an inch, or slightly more, in length, which was observed in 1892 doing much harm in one district to Strawberry leaves. The beetle may be easily identified from description with the help of a fairly strong magnifier. It is oblong-ovate, and convex in shape, and the general colour is of some shade of dull yellow, or brownish. Looked at more minutely, the head is yellow, with a broad black stripe or band across the top. The thorax or fore body also of some yellowish tint, with, in some instances, a dark line along the central furrow, and on each side of the furrow is a small round depression. The wing-cases pitted, so as to be slightly granulated, on the surface, and rather shiny, and in the specimens sent somewhat variable in colour, sometimes yellowish, sometimes of a brown tint, with the margin and the suture yellow, and occasionally a spot on the shoulders of a dark brown. The body black beneath, with the tip of the abdomen pale; legs pale; and the horns long, palest at the base, black towards the end.

This kind is recorded as being found "in this country in July, frequenting Willows, Alders, &c."; and in Germany it is mentioned by Kaltenbach as being repeatedly noticed by himself on young plants of *Spiræa ulmaria* (Meadow Sweet), and "once in greater numbers" on the *Potentilla anserina* ("Silver Weed" with us), of which it greatly damaged the leaves by its gnawings.

The *Spiræa*, and still more the *Potentilla*, are nearly allied to the Strawberry, so that it is not surprising that it should be found on this plant; but still, until the observation of it was sent from Hants, I was not aware of it having been noted as a Strawberry pest. Plentiful samples, both of the beetles and of the injured leaves, were sent me on the 27th of July, from Hundred Acres, Wickham, Hants, with the observation that they were insects which were destroying the Strawberry plants in that neighbourhood. Also that it was considered to be a new pest in the locality. The injured Strawberry leaves

sent clearly showed the great mischief caused by the attack. These were perforated in some cases with irregular shaped holes right through the leaves, and still more injury was done by little patches of the outer skin of the leaves being eaten away, leaving the veins, but quite destroying the attacked parts. So far as had been observed, the beetles were believed to lay their eggs on the under side of the Strawberry leaves, from which presently the grubs hatched out, followed in due time by a second brood of beetles, but the progress of development had not been worked out with precision.

The general history of this *genus* of beetles is, that their larvæ are rather elongate in shape, wrinkled, and with lateral tubercles, and a projection at the tail extremity, which serves as an additional leg. They live in company, and the beetles, and larvæ, feed on the leaves of the same plants, and the pupæ are to be found sheltered in cocoons in the ground.

PREVENTION AND REMEDIES.—So long as the fruit is on the plants, it does not seem possible to use any measures to get rid of the pests on the leafage; but so late in the season as the 27th of July, in warm localities, this would probably not be a difficulty. In such case picking off such of the grub-infested leafage as was much injured would be a very desirable course. Also insecticides, even of a poisonous nature, such as Paris-green or Hellebore, might then be used without fear of poisoning eaters of the fruit.

As it is the general habit of the grubs of the *Galerucæ* to go down into the ground to turn to chrysalids in cocoons, it would probably do good to treat the surface soil beneath the Strawberry leafage in late summer in such a way as would get rid of the infestation, and so forestall the development of a second brood of beetles.

Judging from the observations sent, though the fact is not clearly stated, with details given, there is presumably a second brood, and, if so, this should be looked for, and got rid of in hybernating state from beneath the Strawberry plants during winter. The beetles would probably be found (as is the case with a nearly allied species) harbouring in the dead leaves and rubbish on the surface, and if this was scraped together and burnt before disturbing the surface soil for the customary winter treatment, a deal of infestation would most likely be got rid of.

Eelworm Disease. *Aphelenchus fragariæ*, Ritz. Bos.

The following observations refer to peculiar malformations of growth caused by Eelworm presence so affecting the stems and inflorescence of the Strawberry as quite to change the characteristic appearance of the growing portions of the plant when it should be running on into flower, and thus ruining it for all useful purposes.

From the circumstance of the buds (or the various portions which should have formed the buds and flowering stems) being so greatly swelled at the extremities, and also so shortened and pressed together as greatly to resemble pieces of Cauliflower placed amongst the deformed stems, it has seemed convenient to give the name of the "Cauliflower disease" to this form of Strawberry attack, in the same way that "Tulip-root," "Pine-apple disease," or other names describing the shape of diseased growth, are given to malformations caused by the presence of other kinds of nematoid worms (popularly known as Eelworms) in Oat plants, Carnations, or other field crop or garden plants.

The first observations of this very peculiar attack were sent me from St. Paul's Cray, Kent, on May 23rd, 1890, by Mr. Thomas May, with the remark that he was forwarding me specimens of Strawberry plants from a field of fourteen acres, of which nearly half the plants had gone like those sent. These plants were greatly deformed, and I found Eelworms (and in a further supply of diseased Strawberry plants sent me on May 28th, I found Eelworms in exceedingly active condition) numerous present.

On June 3rd (together with further supply of specimens from the same fourteen-acre field), Mr. May mentioned that half of the plants were affected *equally all over* the field, excepting on a half-acre, where there were Potato clamps before planting, and where they had a large manure-mixen. "These two patches," my correspondent wrote, "look well, all but an odd plant or two here and there—about one in fifty in these two patches; the remainder of the field is just about equal. The plants on half the field came from my own old plants, and the other half from a neighbour's." With regard to the origin of the infestation, Mr. May observed:—"I am satisfied it has nothing to do with the plants when put in; they all grew well last season."

In reply to my enquiries as to cropping or manuring the field in the previous years, Mr. May favoured me with the following report:—

CROP.	MANURE.
1881 to 1884. Strawberries.....	—
1885. Potatoes	{ Heavily manured with London straw dung, and some kainite suppl. ammonia, superphosphate, sown with Potatoes.
1886. Wheat	
1887. Clover, very heavy crop	—
1888. Potatoes	{ Heavily manured (again as before) in winter of 1887-88.
1889. Planted Strawberries, and plants all started well and did well..	{ 1889-90. Manured Strawberries in November and December, and <i>dug</i> in peat moss and sawdust, horse manure from London having lain in in lumps from August.
1890. Strawberries with large quantity of deformed plants.....	

On opening one of the side buds of the plants sent me on May 28th, I found Eelworms of various sizes numerous present, somewhat resembling *Tylenchus devastatrix*, the "Stem Eelworm," which we know well as causing Tulip-root in Oats and stem-sickness in Clover (of which I give a figure on p. 254 for reference). Not, however, having the requisite knowledge of nematoid worms to be able to identify the species myself, I forwarded specimens to Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Holland,* for the benefit of his well-skilled opinion.

On examination Dr. Ritzema Bos found the infesting Eelworms to belong to the genus *Aphelenchus* of Bastian, but not to be identical with any of the species of this genus with which we were previously acquainted, and therefore (as being

DESCRIPTION OF FIGURES.

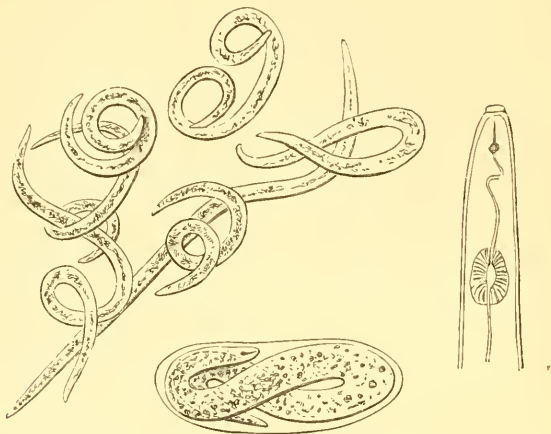
1. Strawberry plant infested by *Aphelenchus fragariæ*.
 - a. Scaly buds developed in the axils of normally developed leaves—*h*.
 - b. A very swollen stem, with
 - c. Rudimentary flower buds always remaining closed.
 - d. Accumulation of rudimentary buds at the base of the branch *b*.
 - e. Cauliflower-like accumulation of strongly branched and broadened inflorescent parts, with imperfectly developed flowers and sheathing leaves.
 - f. Section of similar Cauliflower growth.
 - g. Accumulated blossoms, partly rudimentary, partly abnormally developed, such as are shown separately in 2 and 3.
 - h. Portion of leaf-stalks of normally developed leaves.
 - i. Stunted leaves of fairly normal shape.
2. Monstrously developed blossom; outer leaves of the calyx narrow; inner calyx leaves more developed, some very thick and twisted, others branched, and a few trifid like ordinary leaves; the blossom appears to have split into three divisions, but the petals, stamens, and pistil of these parts have remained rudimentary and indistinguishable from each other.
3. Monstrously developed blossom; outer leaves of the calyx narrow; inner leaves of calyx well developed, but a few of them twisted; petals of corolla stunted, and some of them twisted, and no sign of pistil or stamens.
4. Abnormally developed stamen.

* Now Director of the Phyto-pathological Laboratory at Amsterdam.



Strawberry plant, diseased by infestation of *Aphelenchus fragariae*. By permission, after figure by Dr. J. Ritzema Bos.

previously undescribed) he bestowed on it the appellation of *Aphelenchus fragariæ*, as descriptive of the nematode and its food-plant.



STEM EELWORM (*Tylenchus devastatrix*). Anterior portion of female showing mouth-spear; and embryo in egg. All greatly magnified (anterior portion mag. 440 times). From figures by Dr. J. Ritzema Bos.

The accompanying much magnified figures of *Tylenchus devastatrix* may be taken as giving a general idea of the shape of the Aphelenchi, inasmuch as in both cases these are "long eel-shaped *Anguillulidæ* with a flexible ringed skin"; in both cases also there is a "spear" or "stilet" in the mouth cavity or gullet. The essential differences in structure, which can only be observed with the help of very high microscopic powers, I do not enter on here; but, with the permission of Dr. Ritzema Bos, who was good enough to allow me to extract at pleasure from his elaborately minute paper* on this infestation, I offer just a few notes from his measurements, &c.; and likewise his valuable botanical figure (at p. 253), and some notes from his description of the effect of the infestation on the plant growth.

Dr. Ritzema Bos observes that "this *Aphelenchus fragariæ* is a small species" (the greatest length of such small amount of males and females as occurred in the plants I sent was found by him to be—of males, 0·85 mm.; of females, 0·80 mm.—E. A. O.). "The stilet is small; in one specimen I decided it

* "The Cauliflower Disease of the Strawberry, caused by *Aphelenchus fragariæ*, nov. spec.," entitled "De Bloemkoolziekte der Aardberen, veroorzaakt door *Aphelenchus fragariæ*, nov. spec.," door J. Ritzema Bos (voorloopige mededeling). Overgedrukt uit het Maanblad voor Natuurwefenschappen, No. 7, Jaargang 1889.

to be 0.0094 mm. long. Although this organ is at first sharp and thin, it ends in a blunt knob-shaped swelling. The gullet was indistinct in the specimens I examined; it seemed to be rather twisted. The sucking stomach is oval; there the intestine begins, at first very narrow, afterwards broader. Its wall is finely granulated." Details are given of male and female characteristics, so far as observable: but though larvæ were plentiful in the plants I forwarded in May and June, yet Dr. Ritzema Bos noted with regard to the males and females:—"I did not observe one of either sex which was perfectly mature, containing developed spermatozoa or eggs on the point of being laid. It seems from this as though reproduction only takes place during the latter part of summer."—(J. R. B.)

The following extract describes the effect of the infestation on various parts of the plant, as the stems, buds, flower petals, calyx, &c., which, with permission, I give in the words of Dr. Ritzema Bos rather than my own, as being clearer and much more technically precise than any wording I could myself have offered.

Description of the effects of the infestation on the growth of the Strawberry plant.

"In the axils of the normally developed lower leaves (see fig. 1, *h*, p. 253) numerous thick scaly buds appear, much like the little scales that form on a bulb; these buds never grow new stolons. Sometimes the main stem grows fairly tall to begin with (probably because the plant was not attacked by a large number of *Aphelenchus* at once), but a certain height being attained, it branches very vigorously, and the branches are not only thick and broad, but remain united as they grow, so that there is actual fasciation. There is, however, no ribbon-like broadening, but a thickening, which can be best compared to a piece of Cauliflower; therefore I have indicated the disease caused by *Aphelenchus fragariæ* as 'Cauliflower disease of Strawberry plants.'

"In a few cases a simple ribbon-like broadening of the stalk takes place, and the numerous flower and leaf buds that result are more or less normally developed. Sometimes one side of the stalk or branch grows and fasciates more strongly than the other side; the stem then bends, and may even become quite twisted up. Some stems split at the top of the fasciation into a number of different branches, with more or less normal flowers and leaves. Most commonly, however, the stalk or branch gets scarcely broader, but much thicker; the side branches remain in great part fixed together, and it

is an exception for the buds to be perfectly developed. The deformed plant greatly resembles Cauliflower or Brocoli, according as the different parts are more or less enlarged and attacked, and according as the buds are not at all or only partially developed, or have produced malformed flowers. Some very broad and stunted stalks have buds on the top, pressed together like a cock's comb; and some have them at the sides, spread very irregularly, in consequence of the irregular growth, but growing thickly squeezed together over a large surface. . . . The branches are generally all more or less enlarged (fig. 1, *b*), though a few of them may develop normally; some of the leaves may be normal, but many remain very small, and the leaf smaller in proportion than the stem; sometimes instead of being trifid it is entire, and some are much twisted.

"The sheathing leaves are mostly small, or thick and irregularly twisted. The flower buds are sometimes very thick, while the leafy parts remain thin and scaly; sometimes the leafy parts become much thicker, but remain short, and continue to produce little scales. Often the outer calyx, and calyx, are more developed than the other leafy parts. Sometimes the bud remains entirely or in part closed (*c*), while the outer calyx, and calyx, go on developing normally; but often the flower bud opens.

"The leaves of calyx and outer calyx are frequently abnormal, those of the outer calyx being very thin and narrow, almost needle-shaped; while the calyx leaves, on the contrary, develop more strongly; occasionally they are twisted, and have bubble-like swellings on the under side. Some are more or less cut into; others are trifid, imitating the normal leaf.

"The corona petals sometimes do not develop at all; often they remain rudimentary. Sometimes they are much smaller than the divisions of the calyx, and twist to and fro, generally towards the inside; then they are not white, but greenish white or very light green, though thin and delicate in texture as usual.

"The stamens are wanting in many of the flowers, or are represented by such rudimentary growths that their real nature cannot be recognized; in others, which have a normal anther, the filament is much thicker and shorter than in the case of normal stamens. The receptacle and pistil are often very small, sometimes the latter is altogether absent. . . . It is hardly necessary to add that stems, leaves, and blossoms of fairly normal development may be found on plants that are only slightly attacked by the disease."—(J. R. B.)

(For figure of diseased plant and table of description of details, see pp. 252, 253.)

This infestation was little noticed in the following year, and I am not aware that it has been observed since to any important extent.

We are still without knowledge as to where the infestation came from, and also we do not know what remedial applications may be of service in checking the diseased growths, because these were already fully developed when the attack was first brought under my notice towards the end of May, 1889. Then it appeared to me that as the great number of plants successively sent me were masses of infested malformed growth, the best suggestion I could give was to destroy them as rapidly and as thoroughly as could be done, so as (if possible) to stamp out the Eelworm presence.

The only clue that (so far as I see) we have at present towards checking this special form of attack lies in the circumstance of scarcely any of it (perhaps one plant in fifty) being observed on the spots where, respectively, a manure heap, and also Potato clamps, occupying about half an acre, had been. These spots were dressed with the same peat moss, &c., manure, and in the same proportion as the rest of the field; so this shuts the door on the probability of the infestation being brought in the manure, which suggested itself. But it certainly points to difference in state of surface soil affecting amount of attack. Whether the plants thrive and did better on these spots, and so resisted attack better, or whether the Eelworms which might be present were buried and killed, is at present unknown; but still we may get some practical help towards prevention from the above observation.

The attack appears to be of rare occurrence, but it has obviously power of doing great mischief when it does appear; and as the deformation is so very noticeable, it might be worth while on the first observation of commencement of the mischief to try the effect of some of the applications which have been found to answer well for checking "Stem Eelworm" sickness in Oats and Clover, for which I give a few recipes.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in stopping the disease and bringing a good crop; also at the rate of about $\frac{1}{2}$ cwt. per acre it has done well.

As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates brought remarkably healthy plants, with few exceptions.

A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones

two parts; this at the rate of $1\frac{1}{2}$ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

The above, it will be noticed, are *not* recipes for prevention of *Aphelenchi* in Strawberry plants, but of *Tylenchi* in Oats and Clover, but there is so much in common in the nature of the two attacks that experiment might very likely give good results.

Strawberry-leaf Button Moth.

Peronea ? *comariana*, Zell.; *P.* ? *comparana*, Hüb.



PERONEA (? COMARIANA). *—Moth, and caterpillar hanging from leaf by thread. (Figure drawn by Dr. Ellis.)

The following observations refer to the attacks of a small moth caterpillar which some years ago (and possibly still, if

* The *Peroneas* form a genus of exceedingly small moths somewhat uncertain in distinguishing points. The above specimen having been variously named by two referees, I give both appellations.

Strawberries are still grown there) did much mischief to Strawberry leafage in the neighbourhood of Dee Banks, Chester. The notes were kindly forwarded to me in 1883 by Dr. Ellis, of Liverpool, to whom they had then been communicated by Mr. Richard A. Wrench, of Dee Banks:—

“I enclose specimens of a grub which infests the Strawberries about here (Dee Banks, Chester), and does a great deal of harm; the bulk of the Strawberries for Liverpool market are from here. I may say it usually makes its appearance about the beginning of May, and lasts until about the end of August, when it goes away.

“Young Strawberry plants of twelve months old are never affected; two-year-old plants are affected rather badly, but three-year-old plants are invariably ruined.

“I have two fields adjoining one another, the old field utterly ruined by the grub, the next, only separated by a hedge, perfectly clear; but next year, when it will be two years old, it is sure to be full of blight.”

For the following description of the moth (*P. ? comariana*) in its three stages I am indebted to Dr. Ellis:—

“*Larva*.—Cylindrical, shining, slightly bristly; head glassy, pale yellow, with brown spots on each side behind; general colour green, darker above, lighter below, with the dorsal vessel well marked and darker. *Feeds in May and early part of June on Strawberry, drawing together the leaves and flowers for this purpose; in the latter case feeding on the calyx and receptacle.*

“*Pupa*.—Pale green, with reddish wing-cases and abdominal segments.

“*Imago*.—Fore wings very pale ochreous, slightly darker on the hinder half; near the middle of the costa is a dark brown, nearly black, triangular blotch, reaching two-thirds across the wing, and continued to the inner margin as a slight brownish cloud. A dark patch on the inner margin indicates the edge of the basal patch. Hind wings grey.”

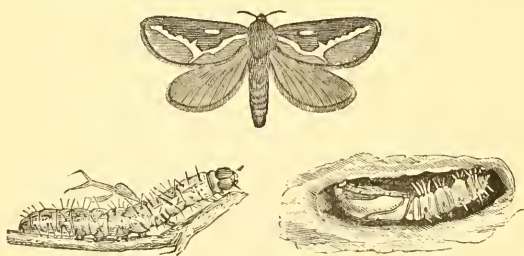
PREVENTION AND REMEDIES.—Before we can be sure of these we need fuller details of the life-history. So far as I am aware, we do not know where the caterpillar turns to the chrysalis condition; but it will be noticed in Dr. Ellis's sketch that the caterpillar is suspended at the end of its thread, and as it has the means of lowering itself to the ground, it seems very likely that it may go down to the ground, or to rubbish on the surface of the ground, for the pupal change. No observation at least is made of pupation taking place amongst the spun-up leaves, &c., in which the caterpillar feeds.

In Stainton's 'Manual'* it is mentioned of the family of *Peroneidae* that "the insects appear in the perfect state at the end of summer and beginning of autumn, and by far the greater number hibernate, and are to be met with throughout the winter and in early spring."

The infestation appears to harbour about the Strawberry grounds, for it will be seen above that Mr. Wrench notices attack is *absent* in the first year, *moderate* in the second, but *devastates* in the third, which points to the attackers being on the spot; for if the little moths *flew* from neighbouring localities there does not appear any reason why the first years' plants should escape.

In our present imperfect knowledge of the habits of the infestation, the only plan that suggests itself is such slight skimming off of the surface soil, and removal of this and remains of dressings, after the crop is over, as might remove the chrysalids if present, and also (later on) turn out all the moths which might be hibernating in the surface rubbish.

"Small" or "Garden" Swift Moth. *Hepialus lupulinus*, Linn.



HEPIALUS LUPULINUS.—Moth, caterpillar, and chrysalis.

The Small or Garden Swift Moth is a very common insect; but in caterpillar state it is seldom reported, although, when it does appear, it has a power of doing mischief, truly described by John Curtis long ago as scarcely equalled by the Surface Grubs. This is one of the attacks which *really* is much influenced by weather. The season of ravage is autumn, winter, and spring, and though we have no record of cold killing these grubs, it keeps them quiet; whereas in an open winter like that of the early part of the year 1896, they can creep about in the unfrozen ground and feed as they please.

Amongst bush or ground fruits the infestation is injurious

* Stainton's 'Manual of British Butterflies and Moths,' vol. ii. p. 229.

at the roots of Strawberries and Raspberries; amongst kitchen garden crops it infests Celery, Lettuce, Parsnip, and Potato; but it is obvious that no local preventive applications can be trusted to for keeping off attack, as the presence of the moths is so very general. They are especially recorded as being found at laying time hovering over grassy places, and I have had the caterpillars from grass land being ploughed up in February. In October I have had them from Clover leys, where they were found in such numbers that the farm bailiff asked for information, as the ground he was ploughing up "was covered with them." Similarly, I have had them in November from the surface soil of land being ploughed after Peas, and in spring from winter Beans put in after Wheat, and looking at the variety of crop subject to this infestation, it seems a hopeless matter to find any preventive measures against egg-laying.

The caterpillar is of the shape figured at p. 260 when full-grown; about four-fifths of an inch in length; cylindrical; white or yellowish white, with the head and the plates or collar on the segment next to it of some shade of brown; and the usual dots on the body dark or of a pale yellowish tint, each of these with a stiff black hair; and the spiracles black. Earlier in their lives, these four dots on the back of each segment after that next the head are dark. The caterpillars are sixteen-footed,—that is, with three pairs of claw-feet on the segments next the head, four pairs of sucker-feet beneath the body, and one pair beneath the tail. They are somewhat variable in colouring, even to being *entirely without* any tint on the spots.

The chrysalis is of a somewhat long cylindrical shape, as figured at p. 260; shiny and very sensitive; and in colour of some shade from ochreous to pale reddish brown, darker on the head and wings; and showing the shape of the forming moth, and of the legs and wings within it very clearly.

The moth is variable, both in size and colouring; the spread of the fore wings may be from an inch to an inch and a half; and the colouring may appear wholly of a dirty pale brownish, or, if characteristic, be of a clay colour or pale brown, "with a whitish streak from the base towards the inner margin, and an interrupted whitish streak from near the inner margin to the apex." As the names differ as much as the varieties, I have taken Professor Westwood's name of the "Small Swift," which distinguishes it well from the much larger kind (the "Ghost Moth" or "Hop Swift"), the caterpillar of which specially attacks Hop roots. The name of "Swift" is given on account of the rapidity of the flight. The moths may be seen in the evening by hedgerows or grassy

banks, over grass, where they drop their eggs in large numbers.

The moth appears about the end of May to the middle of June; the caterpillar is to be found from the end of September until April, and towards the end of April or in May it turns to the chrysalis.

I have never had specimens of this infestation as a Raspberry root attack, but I have had them in January, apparently full-grown, with the information that the grubs were found at the roots of the Strawberry plants, which they killed by eating holes in the stems.

PREVENTION AND REMEDIES.—Whether anything can be done at a paying rate to get rid of the grubs does not yet appear. With Strawberries and Raspberries hand-picking *might* answer, for children could be employed at a small cost, and under superintendence. Trapping might very likely do good, by arranging the baits of pieces of Potato, or Parsnip, or anything the grubs were found to prefer to the crop they were ravaging, in the same way as in garden trapping of Wireworm,—that is, passing a stick through the bait, so as to show where it has been buried a little below the surface, and every two or three days raising the bait, clearing the grubs, and reburying the piece of Potato, or whatever it may be.

Where circumstances admit of disturbing infested ground in winter, so as to throw the grubs open to cold, or alternating cold and thaw, this would get rid of great numbers.

WASPS.

Ground-building and Tree Wasps. *Vespidae* of various species.



Nest of Tree Wasp, after sketch from original specimen by Eleanor A. Ormerod.
Dimensions eight inches across by seven and a half deep.*

The injuries to fruit and losses to fruit-growers and gardeners by Wasp depredations on the ripe or ripening crops are to a greater or less extent a yearly trouble, but in no season for many years has this been so great as in 1893, when the visitation was so numerous and severe that it was known as the "Wasp plague," and may be taken as an example of the loss and mischief which a great Wasp infestation *can* cause.

* As the tenants of the nest were not identified at the time, I cannot say with certainty whether it is that of *Vespa sylvestris* or *V. norvegica*.

The very unusual prevalence of Wasp presence in 1893 was reported from almost every one of the many localities in England from which replies to my enquiries were forwarded to me, and though the infestation was not so general in Scotland, it was exceedingly troublesome over some large districts, notably by the Moray Firth, in the Lothians, and in some of the islands on the west of Scotland.

Great losses were caused by the quantity of fruit ruined, up to almost wholesale destruction in the grounds of large fruit-growers, and the following few extracts give some idea of the extent of local damage in various places.

One report mentioned that the Gooseberry crop was completely cleared when approaching ripeness; quite two-thirds of the Pears had been damaged and destroyed; Apples about one-third; Plums about half.

From another locality the damage done to the Plums was mentioned as so great that consequently many had to be gathered before they were fully ripe; that large quantities of Apple-skins which had been completely hollowed out by the Wasps were lying underneath some of the Apple trees, scores of bushels having been destroyed; and the Grapes (it was noticed) "they have also very much damaged, and it has been needful to cover all openings in the houses with fine net in order to exclude the Wasps." At another locality (like the preceding, in Sussex) the damage to fruit, and especially to Grapes in the houses, was reported as very great; and from the Estate Office, Maresfield Park, near Uckfield, Sussex, Mr. Mark Sandford wrote me:—"Heavy losses have been sustained, as some best fruits have been utterly eaten up; all our Peaches were eaten before they were ripe, we could *not ripen a single one*. All our out-door Grapes were eaten, and many of our best eating Apples cleared out, leaving only the peeling."

The above notes give an idea of the amount of mischief in places in one county in the extreme south of England, and those following, which are part of some valuable observations with which I was favoured by Mr. C. Webster, Horticultural Superintendent to the Duke of Richmond and Gordon, from The Gardens, Gordon Castle, Fochabers, N.B., show that the prevalence of the "Wasp plague" was no less destructive in that northerly part of Scotland:—

"It was about the last days of July that my attention was first called to the plague of Wasps, by their attack on the wall Cherries. We could find no protection from their attack upon this fruit, a large proportion being consumed by them. Some of the trees, when the nets were shaken, had the appearance, for a few seconds, as if a swarm of Bees had

come off. As the different sorts of wall fruit ripened, such as Apricots, Peaches, and especially Plums and Jargonelle Pears, it was attacked by swarms of them. Even hard Apples and Pears (which had been pecked by birds), and quite devoid of saccharine matter, were fixed on as greedily as some of the softer fruits. The plague continued from the end of July to the second week in September, at which time we had our first frost, cutting up Dahlias, Begonias, and other tender plants, and also putting a check to the quantity of Wasps."

In regard to *benefit* or *injuries* received from the Wasp presence, the evidence shows unquestionably preponderance of the latter.

The great amount of injury inflicted by them in serious losses to fruit-growers, and pain, risk, and inconvenience by their extraordinary amount of infestation in houses, and their attacks (or onslaughts, rather) on men and horses when disturbed in the fields, are matters of very demonstrable evil. Detailed accounts of these and of other inconveniences and losses are given in my special observations of the great "Wasp plague" of 1893.* But relatively only to the special consideration of fruit injury, it is manifest that where good fruit (and it will be noticed how, in some instances, the best and choicest kinds are selected) is destroyed by bushels, the use of bags by thousands necessitated to endeavour at least to protect it, and possible entrance of the marauders into vineries, fruit-houses, &c., prevented by netting, that there is a very tangible amount of loss and trouble.

The Wasps' nests, besides being much more numerous than in ordinary years, were noticed in some instances as being of greater than the customary size, and more numerously tenanted. From contributors who especially attended to the numbers of nests destroyed, or kindly obtained information for me, I had notes of destruction of over one hundred and eighty nests on somewhat less than six hundred acres of land; two hundred nests taken in one nursery garden; an estimate of about three hundred nests taken on three hundred acres; and in one instance, where a bonus of sixpence per nest was given, three hundred and seventy-six nests were taken within half a mile of the kitchen garden, which was the centre of operations, and later on payment was made for ninety-four more, within the same area, or a little further away,—four hundred and seventy in all. Other notes gave twenty nests ploughed up in one field; three dozen observed, or taken, in the radius of a quarter of a mile; twenty-three nests in ninety-six yards of dry stone wall, or dyke, &c. Of Hornets,

* See my 'Seventeenth Annual Report,' pp. 111-140.

in one locality, nine nests were known of within the limits of "a ramble," and twenty in the more extended area of a few miles.

It is worth noting, that from two well-qualified observers respectively almost at the north and almost at the south of the area reported from, namely, localities in Co. Moray, N.B., and Kent, and also from a station midway, namely, Hull, I had information that *no* unusual amount of appearance of queens in spring preceded the very unusual amount of Wasp infestation afterwards.

Where the observers expressed an opinion as to the cause of the very unusual prevalence, it was referred, as indeed seemed clearly demonstrated, to the unusually early and long-continued dry weather in the spring being so entirely suitable for satisfactory settlement of the queens.

Species of British Wasps.—In Britain we have seven species of social Wasps, that is, of Wasps living together in societies



VESPA VULGARIS.—Largest specimen, queen, or female; specimen to left-hand, with long horns, drone, or male; right-hand specimen, neuter, or worker.

formed of males, females, and neuters, or abortive females, commonly known, respectively, as drones, queens, and workers.

The seven kinds of Wasps are divided into two sections of Ground Wasps and Tree Wasps, according to whether their nests are customarily formed in a hollow in the ground, or suspended in the air from a bough, or in a hedge, or, as with our largest species, *Vespa crabro*, the splendid insect known as the "Hornet," the nests may be found in decayed trees, in roots, under eaves, or, as I have myself found it, down in the ground by a small post of a field paling.

The species of the Ground-building Wasps are *Vespa vulgaris*, Linn. (see figure); *V. germanica*, Fabr.; and *V. rufa*, Linn., which is somewhat smaller, as regards the queens and workers, than the two preceding kinds, but variously marked, especially on the first two segments of the abdomen, with a

red tinge. As I have seen it (especially on one occasion when, by mishap, I had to hold the entire colony of a disturbed nest down on the ground within my ring-net to enable my unwasp-protected colleague to escape), the difference in tint is a very fair general distinction.

Of the four species of "Tree Wasps," the most common are *Vespa sylvestris*, Scop., and *V. norvegica*, Fab. (*V. britannica* of Leach); of these the first is widely distributed, the second is not so common in England, but said to be abundant in Scotland. *V. arborea* is so very rare that it hardly needs mention. I was, however, fortunate enough to find two specimens at Sedbury Park in the west part of Gloucestershire, which, on being submitted to the late Mr. Frederick Smith, of the British Museum, were identified by him as being queens of this species.

The *Vespa crabro*, or Hornet, is easily distinguishable from the other species of Wasps by its greater size and its large



VESPA CRABRO, female.—Queen Hornet.

proportion of rusty or reddish colouring. In the part of Gloucestershire mentioned above, where there was much woodland, it was not at all uncommon, but its range of habitat is given as not extending (as far as is known) so far north as Yorkshire.*

The Wasp colonies of the year are begun by the queens which survived the winter in the sheltered localities which they chose for themselves (away from the perishing nests of the preceding season). Such, for instance, as dark nooks in sheds, or amongst wood, or leaves, or dry rubbish, or stones, or in a dry bank—anywhere, in fact, indoors or out, that is snug and quiet, till the return of sunshine and warmth wakes them from their winter sleep.

Then comes the time at which the state of the weather affects the amount of Wasp increase to a very important

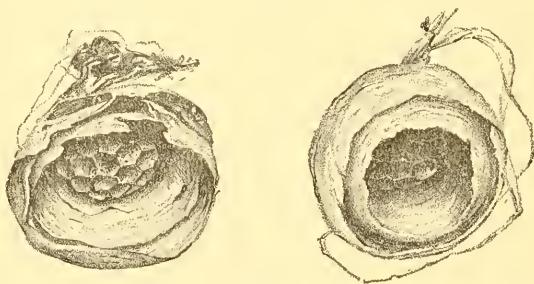
* 'British Museum Catalogue of British Aculeate Hymenoptera,' by Frederick Smith, p. 222.

degree. Wasps are very sensitive to cold and exposure, and when weather varies, as is so often the case in early spring, from short bright sunshine to frost, or sleet, or snow, many of the queen Wasps which are caught by the unfavourable weather perish, and their embryo nests, with their few eggs or lately hatched grubs, perish also.

This embryo nest is made of a kind of grey paper formed of morsels of wood, or of bark, or material of a similar kind, worked by the Wasp into a kind of paste or "papier maché," and spread into the required form by her jaws, and it is obvious that where this delicate structure of *perishable* material is exposed to bad weather that it will most likely *perish*.

When the tiny structure has advanced so far as to have any definite form, it may be described as much resembling a miniature open umbrella formed of thin grey paper, about half an inch to an inch in diameter, and hung by a little stout peg, also made of paper-like material, to whatever support the queen Wasp may have chosen. Continuing the comparison,—beneath this convex umbrella-shaped cap hung up by the peg above is, not a handle, but a short somewhat club-shaped mass, at the lower extremity of which are a few cells containing eggs or Wasp maggots.

At first the queen has to carry on all the work of the commencing colony: to lay the eggs, feed the grubs, gather



Wasps' nests in early stages, after photos by Dr. Edw. L. Ormerod.

material for house-building, and use it herself for enlarging the roof of the family shelter, or for deepening the cells (which at first were little more than cups) so as to suit the needs of the growing grubs. Thus the first hood is enlarged, additional layers of paper are added, until the little nest begins to take its characteristic spherical form, and the few cells with which work began are increased in depth and numbers until they become a regular layer of paper Wasp-comb. The accompanying figures show this condition before the nest has been

closed below, so as only to leave the requisite aperture for Wasp passage.

From this time, if all goes well with the colony, the work goes on regularly. The queen continues to lay eggs, and the egg condition is stated to last eight days, the larva state thirteen or fourteen, and that of the pupa about ten; thus (speaking generally) in about a month from the time of the first eggs being laid, the first Wasps of the season begin to make their appearance. These are all abortive females, known as workers, and as they keep on developing in steady succession, from the succession of eggs laid by the queen, they carry on the labours of the rapidly increasing community. Successive tiers of horizontal comb, with cells on the lower sides, have to be built to receive the eggs and accommodate the grubs, and the outside of the nest has to be enlarged correspondingly, until, in the case of the common Wasps, it may be of a somewhat spherical shape of any size from two or three to eight or more inches in diameter. The Hornets' nest is very likely not entirely spherical, but built against the side of a cavity in an old tree; also the paper is of a coarser kind. The largest specimen I have seen was fully nineteen inches in height by fifteen in breadth.

The building of the outside of the nest is carried on by the workers stripping or rasping up small quantities of wood or vegetable material, and working these with moisture from their mouths into little pellets, which each worker carries home, as it is commonly described, in her jaws, but (from my own observation of the process) I should rather say *under them*, tucked, as it were, under her chin. Thus her jaws are free for work, and when she gets to her nest (in the case of a kind like that figured at the heading), then placing herself firmly in an inverted position, with three legs on each side of the edge of paper to be enlarged, she walks backward, spreading out her soft paper pellet with her jaws until it forms a little stripe securely joined to the former paper, but differing in colour according to the tint of the wood, or vegetable material, of which it has been made.

The horizontal layers of comb within the nest are formed of the same kind of paper as the outside casing of the nest, each comb being suspended from the layer above it by short strong pillars of the Wasp-paper material, thus giving convenient room for traffic of the workers on the flat top of each comb whilst attending to the needs of the young family in the cells of the comb immediately above them. All the labours (excepting egg-laying), whether building or repairing, fetching materials and food, clearing out rubbish, &c., have to be carried out by the workers, and in the case of ground-

builders, the mere enlargement of the cavity to give room for the necessary enlargements of the family establishment is no small labour; and for those who can watch quietly it is a very pretty sight to observe the workers coming up from below laden, each one, with the little morsel of earth or pebble which was required to be excavated.

Towards autumn the economy of the nest changes, males and females are produced, and shortly after the Wasp colony, as a social establishment, comes to an end. The drones, or males, having fulfilled their allotted work by pairing with the females, die, so also do the workers; the nest decays, and all that remains of the summer colonies and their quarters (excepting where nests may have been built in some dry locality where they are as safe as in a cabinet) are the females, which will leave the nest, and, hybernating in their selected shelters until spring comes round again, thus complete the year's circle of Wasp life.*

PREVENTION AND REMEDIES.—The following notes give details of methods of operation, or recipes for applications, found effective in destroying Wasps' nests, amongst which it will be seen that *cyanide of potassium* is especially mentioned as efficacious; but, this being a VIOLENT POISON, I do not *advise* the use of it myself, and do not think that the use of it should be even permitted, excepting in absolutely trustworthy hands.

During an experience of a good many years, in days gone by, I have found one of the most convenient methods of destruction of nests of Ground Wasps (both as doing the work thoroughly and without danger to the operator) was pouring a ladleful or part of a ladleful of tar down the entrance passage into the nest at a time when most of the tenants are at home. If this is properly managed, and there is only one entrance to the nest, probably the work will be complete, and nothing more needed than to dig up the nest and destroy it after a few days, so that Wasps that may develop within may not make their way out when the tar has dried. Sometimes the ground nests have two tunnels down into them, and in this case the opening of the second one will soon become obvious from the increased traffic and will need attending to, as well as the main entrance. In case the nest is a strong one, and care has not

* In the above account of the general points of Wasp life and habits I have written mainly from my own observations, taken many years ago, when collecting and observing to help my late brother Dr. Edw. L. Ormerod, of Brighton, whilst preparing his volume entitled 'British Social Wasps,' regarding such points as required local attention in their own habitats. And to this work I refer the reader for the results of my brother's minute microscopic investigations into the anatomy of Wasps; and also the reproductive powers of the abortive or partially-developed females commonly known as workers.—E. A. O.

been taken to apply the tar when most of the Wasps are within, there may be temporary trouble from the excluded Wasps forming an attempt at a settlement by making paper in irregular patches amongst the grass round the entrance to the nest. This requires attention, lest accidents should result from it being stepped into at unawares.

The following notes were given me by Mr. W. Gardner, then of Bekesbourne, Kent, relatively to method of taking about a hundred and ninety nests :—

“I think about half were taken, or supposed to be completely destroyed, by cyanide of potassium, mixed in the proportion of two ounces of cyanide to a pint of water; the others were destroyed by pouring in gas-tar, or a sulphur mixture, as they used to do formerly. My old gardener always used pieces of Elder tree from which he had abstracted the pith, and they were filled with a proper admixture of brimstone, &c., but I have forgotten the proportion. They went off like a squib.

“My man who used the cyanide said it was wonderful to see the instantaneous effect it had on the Wasps, and we found that the best way was to give them some; the next day to catch the stragglers that had stayed out during the warm nights, and then dig them out, and crush all the hatching and unhatched larvæ. Indeed, even when using the tar, digging out is requisite to make sure of destroying them.

“I remember one case I had where the hole ran upwards, so I stopped the entrance, and then got a pointed iron rod, six or seven feet long, on which I put a piece of gas-pipe, about half the length or less, and then running the rod carefully into the ground I soon found when I had come upon the nest. I then drew out the rod, and poured in a quantity of gas-tar, which effectively did its work.

“The cyanide process is very simple. We dip a piece of cotton-wool in the mixture and put it upon a pointed stick, and push it pretty well into the hole; of course it needs to be in the hands of a trustworthy person, being such a *violent poison*.”

The above observations of numbers and treatment of Wasps' nests were taken from an area of somewhat less than six hundred acres of ground, thus giving an average of somewhere about one Wasps' nest to every three acres.

From Canon Court, Watlingbury, Kent, Mr. Edw. Goodwin, after mentioning the great strength (in number of Wasps) and also the unusually large average size of the nests, added :—
“We made a great onslaught on them in June, most people using cyanide of potassium, which I have myself used successfully for years.”

From Coosenwartha, Scorrier (Cornwall), the following ob-

servation was sent me on September 7th by a correspondent regarding amount of presence of Wasps:—"They never were so plentiful in this county as at present; indeed, they are a nuisance. . . . I used to destroy them by screwing paper thus" (here a sketch was given of a piece of paper twisted into a funnel shape), "tarring the outside and thrusting it into their holes, and in the night pouring paraffin and setting fire to it."

The following simple method of dealing with the subject was sent me by a correspondent from near Hull:—"Remedy. I always fill an empty cartridge-case with about one part flour of sulphur to four parts of gunpowder, damp slightly, attach a lighted fuse, and place in the hole leading to where the swarm is located; in ten minutes everyone will be suffocated."

Independently of special recipes for use by owners or others connected with the matter, the simple expedient of offering a small *bonus* for each nest destroyed sometimes saves a deal of trouble. In the instance noticed at p. 265 from a locality in Sussex where the Wasp plague was very severe, a sum of sixpence per nest was paid for three hundred and seventy-six nests taken within half a mile of the kitchen garden; but boys, for the most part, delight in taking Wasps' nests, and probably for a much smaller sum a very thorough clearance could be made.

Amongst the various applications of which notes were sent, *cyanide of potassium* appeared the most approved remedy; but its *deadly nature as a poison* requires most careful consideration. The store of it should always be kept under lock and key; and whether used dry or in solution, the packet or bottle should always have a large and legible label—"Poison"; and the application should always be entrusted to known, careful hands.

No method of taking hanging Wasps' nests has been given in the preceding notes, and the rough practice of burning the nest (and a portion of the hedge with it) is entirely objectionable. I have often taken them with perfect safety by simply having strong leather gauntlet-topped gloves, with linen tops sewn on to them, down which I could pass my hands, and then had these tops safely tied round over my sleeves between the elbow and wrist. Thus no Wasps could hurt my hands, and my head was defended by a large piece of some kind of muslin or net (strong enough to keep the Wasps out, yet open enough for me to see through) thrown over the top of a *quite broad-brimmed* hat, so that it hung well down all round, and the lower edge was securely fastened by pins round the shoulders and across the chest. Doubtless a bee-dress would

be more in form, but bee-dresses cost money, and are not always easily procurable.

It is necessary to have the hat with the brim of sufficient width to keep the veil well off the face, and I preferred the kind of patterned muslin or lace, as it is called, of which window curtains are made, as the differences in thickness prevented the first rush of all the Wasps in the nest striking so audibly and directly at my hat. It may be that some people would not mind it, but the first minute of work with hundreds of enraged Wasps all endeavouring to sting was to me always a time of intense nervousness, and I would not advise anyone to try the experiment who cannot be thoroughly trustworthily fastened up, or the results may be serious.

For catching Wasps, no plan seems to succeed better than hanging bottles (as noted by observers) partly filled with a mixture of beer and sugar. But where there are long ranges of Peach walls, or walls with fruit such as the Wasps delight in, I have seen glass-traps also answer very well indeed. These were made by taking a common square hand-glass with a pointed top, and a finger-hole just at the highest part. This glass was set on four bricks, one beneath each corner, so as to raise the glass by the depth of the brick from the ground, *not* by the width, which would allow too much space. On this lowest glass another is placed, taking care that any opening round the edge, where the upper glass rests on the lower one, is well closed with moss, and the finger-hole at the top of the upper one (*not* of the lower one) also carefully closed.

All that is further needed is to throw some fruit, such as the Wasps like, beneath the trap. The Wasps will go to it readily through the opening between the glass and the ground, but coming away is a very different matter. Then they usually fly upwards, and, passing through the open finger-hole into the upper glass, they are trapped, and perish. I have seen a deep layer of flies and Wasps thus trapped, to the great saving of the fruit on the adjacent trees.

For prevention of entry of Wasps into rineries, though the necessity of the matter is alluded to in the foregoing observations, no precise details have been given, I have known it answer quite well to fasten muslin, such as old window-curtains, to the edges of the lights and the framework to which they fitted when the lights were closed. If this is done carefully, there is little damage from the tacks (used to fasten the muslin) to either the paint or wood-work, but care must be taken to allow plenty of muslin, or the lights will necessarily not open as wide as is needed. Also the muslin must be so arranged as not to get in the way of the lights

being closed, or to allow apertures which the Wasps will almost certainly discover.

No observations were sent in on one point which touches us all very nearly,—how best to lessen pain and injury from stings; therefore the following extract from the work of my brother, Dr. Ormerod, on Wasps (referred to at p. 270), may be of interest:—"Ammonia or soda will sometimes relieve the pain, and chloroform more certainly and speedily should it be at hand. Ipecacuanha is a favourite Indian remedy. But the best way is gently to withdraw the sting, and suck the wound if we can get at it, and then to leave it alone. Some persons swell very much after a sting, and for these rest, and a good dose of purgative medicine, are the best remedies." Some few words are added on the importance of leaving the wound itself alone, that is, not teasing or squeezing the part.

APPENDIX.



APPLE.

Pith Moth. *Laverna atra*, Haw.

This is a small moth, only half an inch across in the spread of the fore wings, which are almost entirely black, or richly mottled with black, dark brown, and sometimes a little rusty brown; the inner margin white to beyond the middle, the white continuing in an irregular streak towards the tip; the fringe long and grey. Hind wings grey, with paler fringes. The head and face white, but sometimes darker.

This infestation is injurious to *Apple* by the small reddish caterpillars, which live through the winter in a boring under the bark of an old twig, tunnelling in spring along the centre of the growing young shoot, and feeding on the pith. Thus the leaves and the blossom-buds beyond the tunnelling are destroyed, and the presence of the attack may be known of by their drooping and dying condition. The attack appears to be very seldom noticed with us in connection with Apple injury; but it may be worth while just to allude to it, as it was observed in two localities in the present year (1898), and in one as causing considerable harm.

The only practicable remedial measure appears to be cutting off the ends of the shoots where the drooping of the leaves or of the stems of the blossom-buds shows the mischief that is going on from the borings of the caterpillars within. If these are carefully collected before the caterpillars change to chrysalids within the shoots, and emerge as the perfect moth towards the middle of July (the 8th and 12th in the two instances of dates accompanying specimens sent me), much might be done towards arresting the spread of the attack.

P E A R.

Pear Gnat Midge. *Diplosis pyricora*, Riley.

On June 15th a note was sent me of observation of the "Midges" laying their eggs in the open blossom of the Pear, as well as on the blossom-buds, in the manner hitherto recorded (see *ante*, p. 122). Possibly, if more than just a chance deviation, the circumstance may have been owing to an accidentally late development of some of the Cecids after the buds were expanded.—E. A. O.

ALPHABETICAL LIST
OF
FRUIT CROPS INFESTED BY INSECTS,
WITH
NAMES OF THE INSECT INFESTATIONS.

In the following List the subjects are arranged alphabetically; and after the name of each fruit tree or crop mentioned in this volume, the names of each of the infestations, to which it is liable in this country, are given under subordinate headings, as of BARK, FLOWER or FRUIT. LEAF, &c., according to the nature of the attack. The insects, it will be seen, are given with their scientific as well as with their popular names and also, so far as possible, arranged together as to kinds, as Aphides, Beetles, Moths, &c.; with the number of the page accompanying, referring to where the detailed observations of each kind of infestation is to be found.

In a few instances, where some one kind of insect (as, for example, Earwigs or Wasps) is injurious generally to fruit, the infestation is entered under its own name, and not that of any tree or crop heading. In the arrangement of observations in the volume, it has been a matter of course, where the ravages of any *species* of insect are confined wholly or chiefly to any *one* kind of tree or crop, to give the observations accordingly; as, for instance, the "Codlin Moth" and "Pear Gnat Midge" are given under the headings respectively of Apple and Pear. But where, as in the case of "Winter Moth," the ravages of some *one* species of insect are injurious to *many* kinds of fruit trees or crops, it has seemed desirable to give the observations under the name of the crop of which injury or treatment was chiefly reported; in this case to Plum, to the extent of 80,000 trees. With this main reference, joined to the record in the following List, after *each* heading, of *all* kinds of insects by which that fruit has been found infested, and also the mention in the observations in the body of the volume of the various fruit trees or bushes to which each insect has been observed to be injurious, it is hoped that there will be no difficulty in identifications as they may be required.

APPLE, *Pyrus malus*.

BARK.—American Blight, *Schizoneura lanigera*, 1. Fruit-tree Bark Beetle, *Scolytus rugulosus*, 197. Mussel Scale, *Mytilaspis pomorum*, 38

BLOSSOM AND FRUIT.—Codlin Moth, *Carpocapsa pomonella*, 9. Earwig, *Forficula auricularia*, 80. Golden Chafer, *Cetonia aurata*, 246. Apple-blossom Weevil, *Anthonomus pomorum*, 45. Apple Sawfly, *Hoplocampa testudinca*, 35. Apple-suckers or Apple Chermes, *Psylla mali*, 42. Wasps, *Vespidæ*, 263.

LEAVES.—Apple Aphis, *Aphis mali*, 6. Plum Aphis, *Aphis pruni*, 146. Cockchafer, *Melolontha vulgaris*, 242. Garden Chafer, *Phyllopertha horticola*, 29. Leaf Weevils: Green, *Phyllobius maculicornis*, 144; Oblong, *P. oblongus*, 141. Dot Moth, *Mamestra persicaria*, 86. Figure-of-8 Moth, *Diloba caeruleocephala*, 16. Lackey Moth, *Bombyx (Gastropacha) neustria*, 21. Large Tortoiseshell Butterfly, *Vanessa polychloros*, 50. Lappet Moth, *Gastropacha quercifolia*, 24. Mottled Umber Moth, *Hybernia defoliaria*, 179. Small Ermine Moth, *Hyponomeuta padella*, 27. Common Vapourer Moth, *Orgyia antiqua*, 135. Winter Moth, *Cheimatobia brumata*, 157.

SHOOTS.—Pith Moth, *Laverna atra*, 275.

WOOD.—Shot-borer Beetles: *Xyleborus dispar*, 185; *X. saxeseni*, 192. Goat Moth, *Cossus ligniperda*, 18. Wood Leopard Moth, *Zeuzera aesculi*, 132.

CHERRY, *Prunus cerasus*.

BARK.—Fruit-tree Bark Beetle, *Scolytus rugulosus*, 197.

FRUIT.—Garden Chafer, *Phyllopertha horticola*, 29. Mottled Umber Moth, *Hybernia defoliaria*, 179.

LEAVES.—Cherry Aphis, *Myzus cerasi*, 49. Common Cockchafer, *Melolontha vulgaris*, 242. Leaf Weevils: Oblong, *Phyllobius oblongus*, 141; Green, *P. maculicornis*, 144. Large Tortoiseshell Butterfly, *Vanessa polychloros*, 50. Mottled Umber Moth, *Hybernia defoliaria*, 179. Winter Moth, *Cheimatobia brumata*, 157. Cherry and Pear Sawfly, *Selandria atra*, 54.

CURRENT (Black and Red), *Ribes nigrum* and *R. rubrum*.

BARK.—Gooseberry and Currant Scale, *Lecanium ribis*, 109. Mussel Scale, *Mytilaspis pomorum*, 38. White Woolly Currant Scale, *Pulvinaria ribesiae*, 75.

BUDS.—Currant Gall Mite, *Phytoptus ribis*, 60.

LEAVES.—Currant Aphis, *Aphis ribis*, 58. Gooseberry and Currant Moth, *Abraxas grossulariata*, 89. Winter Moth, *Cheimatobia brumata*, 157. Gooseberry and Currant Sawfly, *Nematus ribesii*, 101.

SHOOTS.—Currant Clearwing Moth, *Sesia tipuliformis*, 67.

SHOOTS AND FRUIT.—Currant Shoot and Fruit Moth, *Incurvaria capitella*, 71.

GOOSEBERRY, *Ribes grossularia* and *R. Uva-crispa*.

BARK.—Gooseberry and Currant Scale, *Lecanium ribis*, 109.

LEAVES.—Currant Aphis, *Aphis ribis*, 58; Clay-coloured Weevil, *Otiorynchus picipes*, 210. Dot Moth, *Mamestra persicaria*, 86. Gooseberry and Currant Moth, *Abraxas grossulariata*, 89. Winter Moth, *Cheimatobia brumata*, 157. Gooseberry and Currant Sawfly, *Nematus ribesii*, 101. Allied Sawfly, *Nematus consobrinus*, 108. Gooseberry Red Spider, *Bryobia prætiosa*, 94.

SHOOTS.—Currant Clearwing Moth, *Sesia tipuliformis*, 67.

MEDLAR, *Mespilus germanica*.

The Medlar is liable to attack of some of our common Orchard insects, but not apparently to any serious extent, as I have rarely (if ever) received inquiries as to infestation, and therefore it seems unnecessary to do more than just allude to the subject.

NUT, *Corylus avellana*.

BUD GALLS.—Hazel and Filbert Bud Mite, *Phytoptus avellanæ*, 114.

FRUIT.—Nut Weevil, *Balaninus nucum*, 116.

LEAVES.—Nut Leaf Weevil, *Strophosomus coryli*, 118. Garden Chafer, *Phyllopertha horticola*, 29. Cockchafer, *Melolontha vulgaris*, 242. Mottled Umber Moth, *Hybernia defoliaria*, 179. Clay-coloured Weevil, *Otiorhynchus picipes*, 210.

PEAR, *Pyrus communis*.

BARK.—American Blight, *Schizoneura lanigera*, 1. Fruit-tree Bark Beetle, *Scolytus rugulosus*, 197. Mussel Scale, *Mytilaspis pomorum*, 38.

BLOSSOM AND YOUNG FRUIT.—Pear Gnat Midge, *Diplosis pyrivora*, 120, 276. Apple Codlin Moth, *Carpocapsa pomonella*, 9. Apple Sawfly, *Hoplocampa testudinea*, 35. Apple-blossom Weevil, *Anthonomus pomorum*, 45.

LEAVES.—Apple Aphis, *Aphis mali*, 6. Pear Leaf-blister Mite, *Phytoptus pyri*, 127. Leaf Weevils: Oblong, *Phyllobius oblongus*, 141. Green, *P. maculicornis*, 144. Red-legged Weevil, *Otiorhynchus tenebricosus*, 213. Large Tortoiseshell Butterfly, *Vanessa polychloros*, 50. Lackey Moth, *Bombyx (Gastropacha) neustria*, 21. Mottled Umber Moth, *Hybernia defoliaria*, 179. Winter Moth, *Cheimatobia brumata*, 157. Vapourer Moth, *Orgyia antiqua*, 135. Cherry and Pear Sawfly, *Selandria atra*, 54. Pear Lyda, *Lyda pyri*, 137.

WOOD.—Goat Moth, *Cossus ligniperda*, 18. Wood Leopard Moth, *Zeuzera æsculi*, 132.

PLUM, *Prunus domestica*.

BARK.—Fruit-tree Bark Beetle, *Scolytus rugulosus*, 197. Mussel Scale, *Mytilaspis pomorum*, 38.

FRUIT.—Plum Sawfly (? sp.), 182. Codlin Moth, *Carpocapsa pomonella*, 9.

LEAVES.—Plum Aphis, *Aphis pruni*, 146. Hop and Plum Aphis, *Phorodon humuli* and var. *malahæb*, 151. *Phyllobius* Beetles: Oblong Leaf, *Phyllobius oblongus*, 141; Green Leaf, *P. maculicornis*, 144; Clay-coloured, *Otiorhynchus picipes*, 210. Common Vapourer Moth, *Orgyia antiqua*, 135. March Moth, *Anisopteryx æscularia*, 177. Mottled Umber Moth, *Hybernia defoliaria*, 179. Winter Moth, *Cheimatobia brumata*, 157. Cherry and Pear Sawfly, *Selandria atra*, 54. Pear Lyda, *Lyda pyri*, 137.

WOOD.—Shot-borer Beetle, *Xyleborus dispar*, 185. Flat-celled Shot-borer, *X. saxeseni*=*xylographus*, 192. Goat Moth, *Cossus ligniperda*, 18. Wood Leopard Moth, *Zeuzera æsculi*, 132.

QUINCE, *Cydonia vulgaris*.

BARK.—Fruit-tree Bark Beetle, *Scolytus rugulosus*, 197.

FRUIT.—Codlin Moth, *Carpocapsa pomonella*, 9.

LEAVES.—Large Tortoiseshell Butterfly, *Vanessa polychloros*, 50. Cherry and Pear Sawfly, *Selandria atra*, 54. From the Quince being grown in such small numbers in comparison with others of our Orchard trees, little notice appears to have been taken of its infestations. Those above noted are a few which I find more especially named.

RASPBERRY, *Rubus idæus*.

BLOSSOM, BUDS, AND FRUIT.—Raspberry Beetle, *Byturus tomentosus*, 202.
 BLOSSOM, FRUIT, AND YOUNG SHOOTS.—Raspberry Stem-bud Caterpillar,
Lampronia rubiella, 206.

LEAVES OR YOUNG FLOWERING SHOOTS.—Clay-coloured Weevil, *Oti-
 rhynchus picipes*, 210.

ROOTS.—Clay-coloured Weevil, *Otiorthynchus picipes*, 210. Red-legged
 Weevil, *O. tenebricosus*, 213. Small or Garden Swift Moth, *Hepialus
 lupulinus*, 260. (All in grub state.)

STRAWBERRY, *Fragaria vesca* and *F. elatior*.

FLOWERS.—Golden Chafer, *Cetonia aurata*, 246.

FRUIT.—Ground Beetles: *Calathus cisteloides*; *Harpalus ruficornis*;
Pterostichus (Omaseus) vulgaris; *P. (Steropus) madidus*; 233-241.

LEAVES.—Clay-coloured Weevil, *Otiorthynchus picipes*, 210. Red-legged
 Weevil, *O. tenebricosus*, 213. Black Vine Weevil, *O. sulcatus*, 210.
 Strawberry-leaf Beetle, *Galeruca tenella*, 249.

ROOTS.—Small or Garden Swift Moth, *Hepialus lupulinus* (in larval state),
 260. Also *Otiorthynchus picipes*, *O. tenebricosus*, and *O. sulcatus*,
 referred to above.

WHOLE PLANT.—Eelworm disease, *Aphelenchus fragariæ*, 251.

The four following infestations are placed under their own designations
 (not that of any special crop) on account of their being so widely injurious. Of
 these the Red Spider and Root-knot Eelworm are referred to, as, although *not*
insect infestations, the first-named causes much mischief to orchard leafage,
 and from the wide distribution of the second in other countries it may be
 serviceable that its history should be known here.—E. A. O.

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